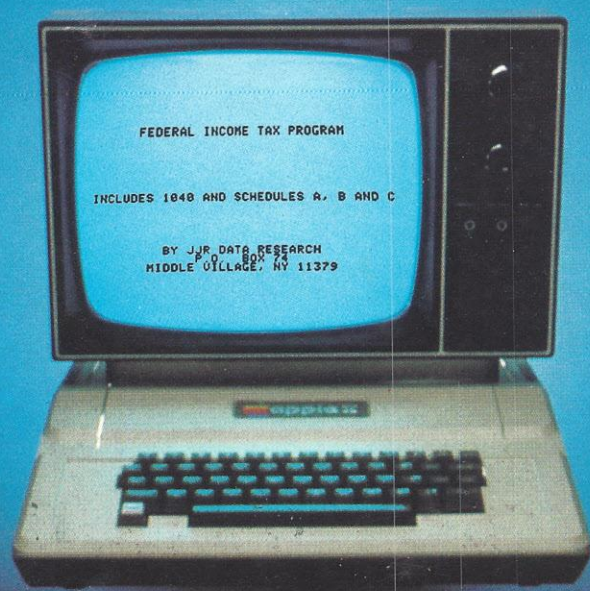
PERSONAL COMPUTING

APRIL 1981
$2.00

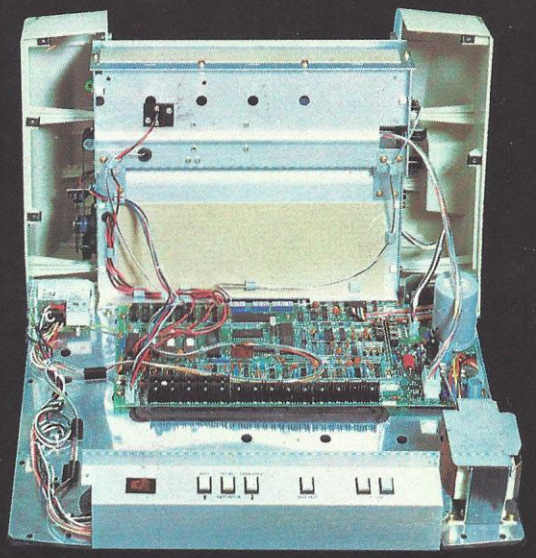
Disk memories:
What you should know
before you buy them

Selecting an assembler
for machine
language programming



Take the headaches out of tax preparation

Say Ahh...



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CIRCLE 1

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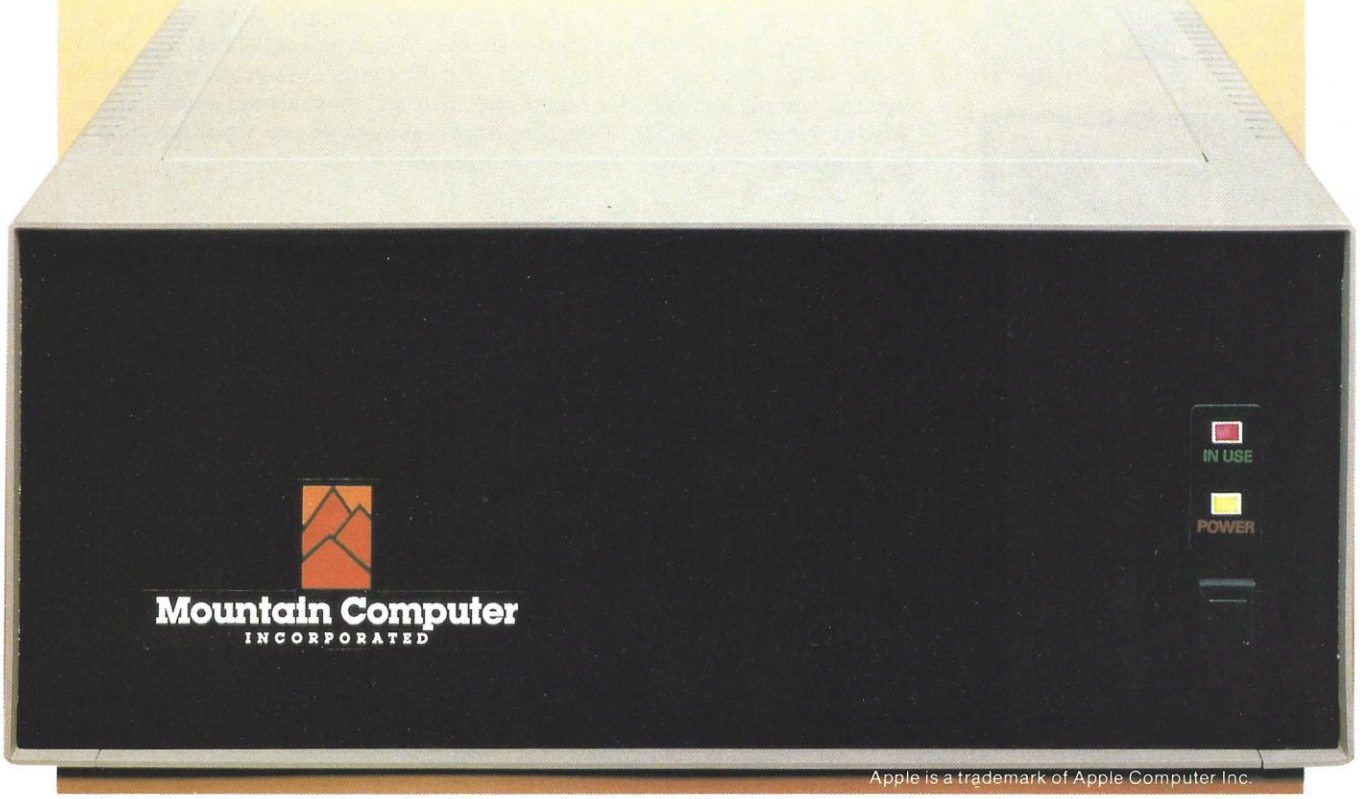

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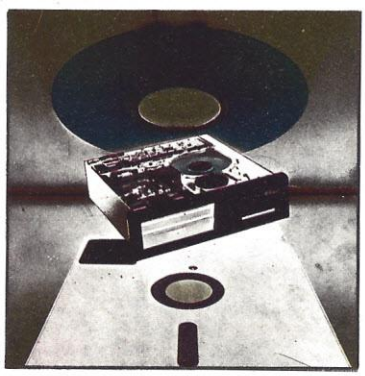
CIRCLE 2

APRIL 1981 VOL. V, NO. 4

PERSONAL COMPUTING MAGAZINE



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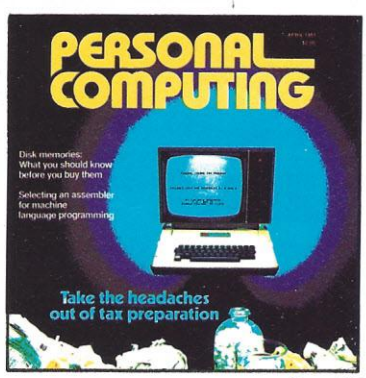

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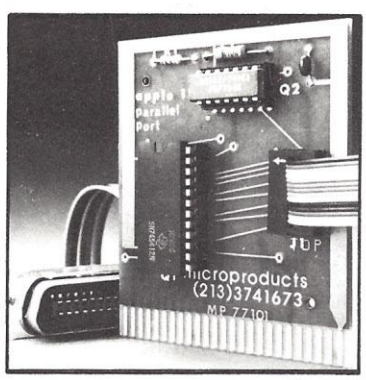

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42,224 copies of this issue printed

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Disk Memories: What You Should Know Before You Buy Them 20
An overview of the disk memory market as it stands today, with detailed information on how to select the best type of disk drive for your storage requirements. This article describes both floppy and hard disks, and examines the pros and cons of each.

Simulation: How Can It Help? 29
The last of a three-part series, this article provides a functional application of a simulation used to help untangle a doctor's office waiting room problem. The information contained in all three parts can help you establish a model for nearly any waiting-line situation, and provide a workable solution to the problem.

Estimate Trip Costs in BASIC or Pascal 33
With travel budgets as tight as they are for both business and personal traveling, it helps to know in advance just how much money you'll need to carry along with you. An effective program for estimating these costs is provided in both BASIC and Pascal versions.

Take The Headaches Out Of Tax Preparation 36
This program will not only figure out your 1040, including Schedules A, B, and C, but it will print out the results in a form acceptable to the IRS. With the help of your TRS-80, those all-night sessions on April 14th will become only a distant memory.

Choosing An Assembler For Machine Language Programming 40
What is an assembler? Why do you need one? Which type is the best for your needs? Which type will be compatible with your present system, or the one you're planning to buy? All of these questions and more are answered here. Also included is a special 27-question checklist to guide you when selecting an assembler.

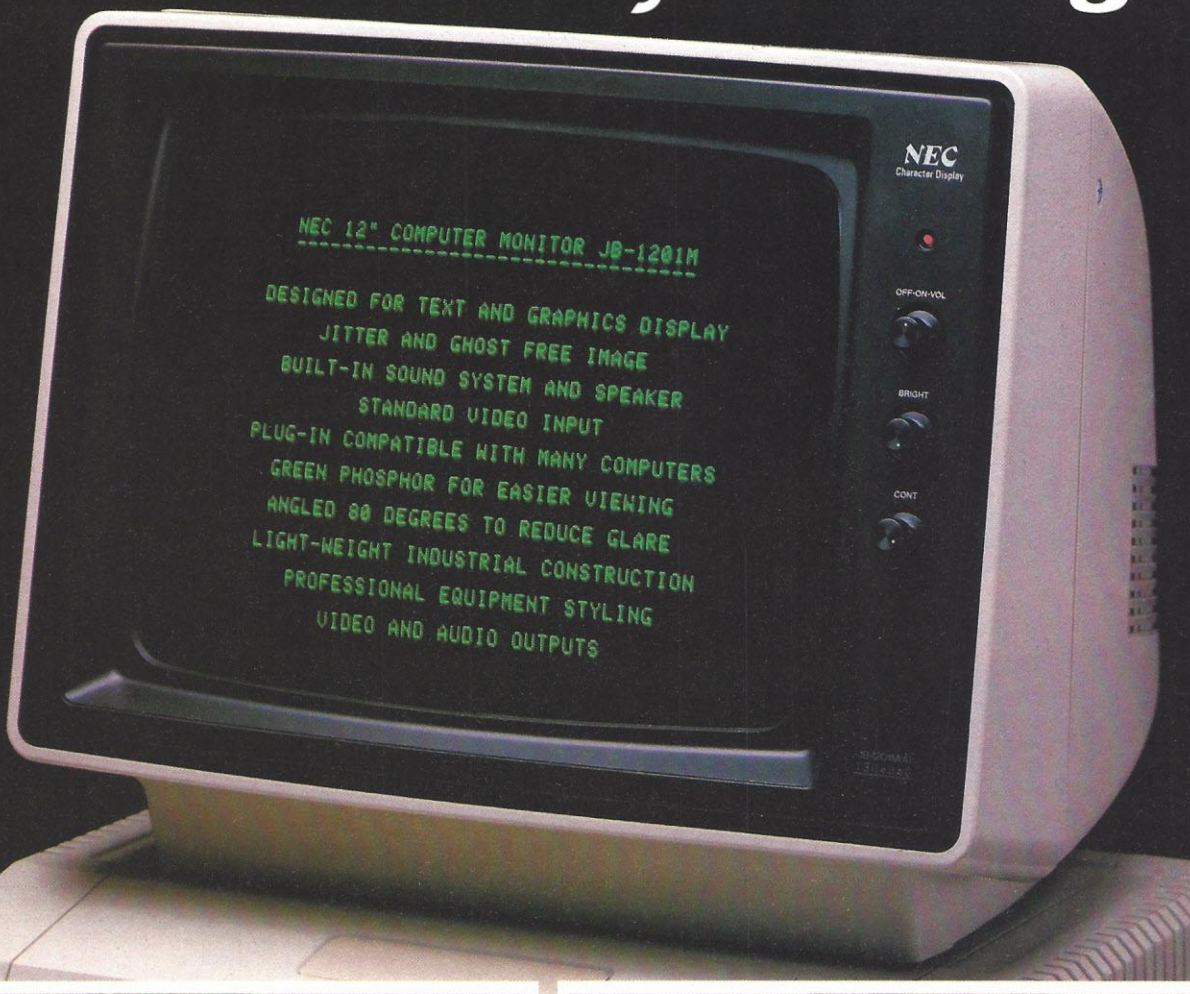
An Introduction To Printer Interfaces 46
Even before you buy a printer, you should know how it interfaces to your computer system. This is a detailed guide to the terminology and technical requirements associated with getting your printer on-line.

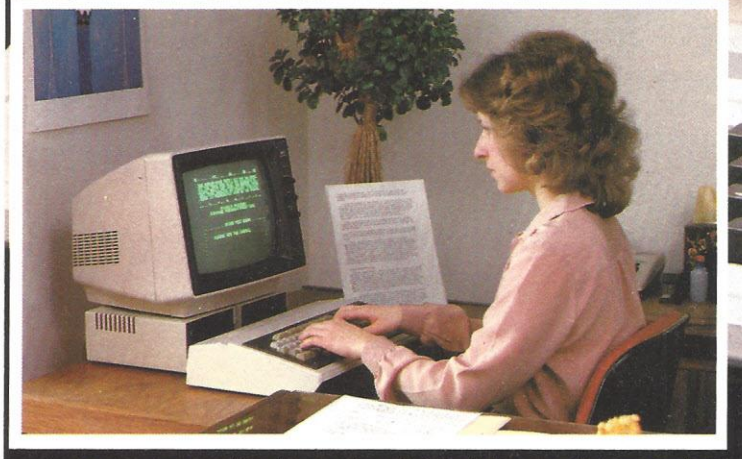
Computers And Education: It's Not All Drill And Practice 51
There's a lot more happening in the educational field than just the "three R's." An interesting look at how computers are helping out is presented here.

How To Boot Binary Programs 56
Here's a sure-fire method to keep your Apple from getting indigestion when automatically booting machine-language programs.

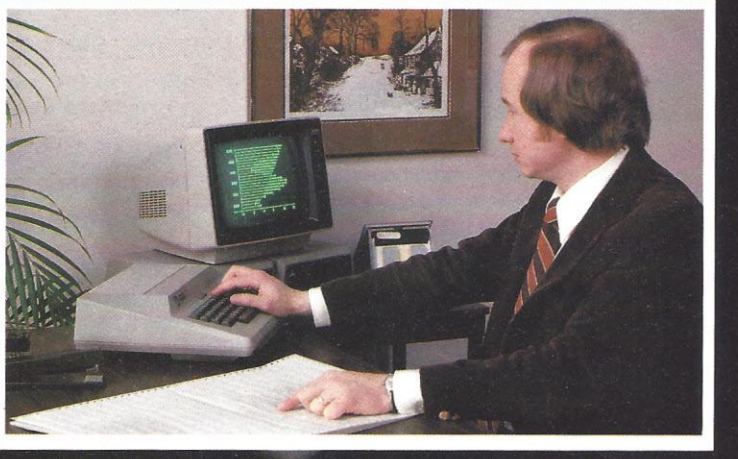
Assessing Project Risk 58
The risk of a project is the probability of failure to meet some criterion, usually time or cost. This article, and its associated program, are designed to use either one of these criteria to come up with a risk assessment profile. This profile is a graph that shows the probability of exceeding the criteria of the project.

Easy on your Eyes and your Budget





80 character display makes it ideal for word processing and scientific applications.



This high quality professional computer monitor provides sharp, clear display of up to 80 characters by 25 lines of text, making it ideal for word processing as well as standard business applications.

Lightweight industrial grade construction gives maximum portability with reliable operation.

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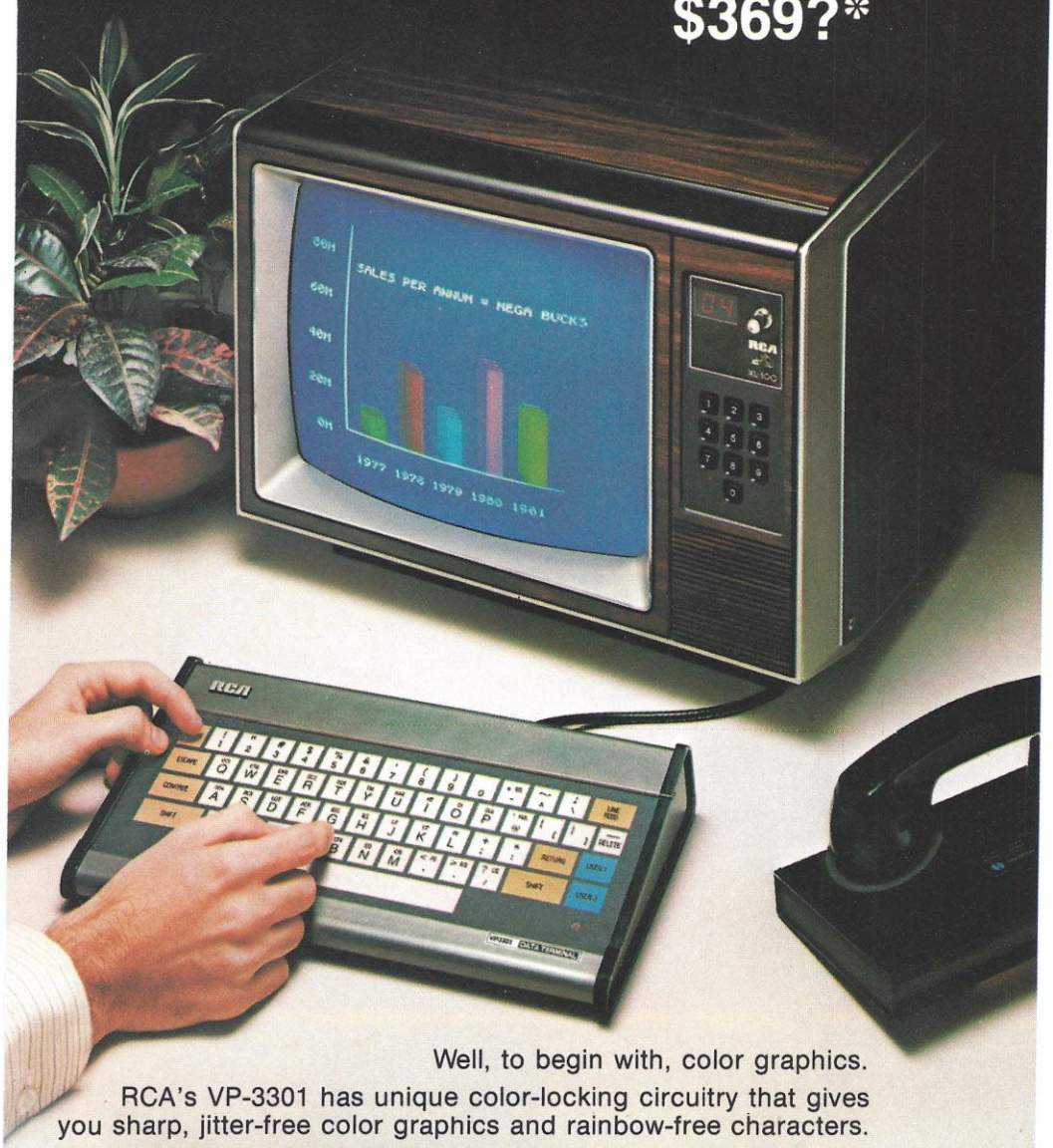
CIRCLE 3

What can you honestly expect from an interactive data terminal that costs only $369?*



Well, to begin with, color graphics.

RCA's VP-3301 has unique color-locking circuitry that gives you sharp, jitter-free color graphics and rainbow-free characters.

Plus much more: Microprocessor control. Resident and programmable character set. Reverse video. State-of-the-art LSI video control. 20 and 40 character formats. RS232C and 20 mA current loop. Six baud rates. Eight data formats. ASCII encoding. Light-touch flexible-membrane key switches for reliability and long life. CMOS circuitry and a spill-proof, dust-proof keyboard for hostile environments.

The VP-3301 can be used with a 525-line color or monochrome monitor or a standard TV set through an RF modulator.** It serves a wide variety of industrial, educational, business and individual applications including communication with time sharing and data base networks such as those provided by Dow Jones News/Retrieval Service, CompuServe and Source.

All this—for the low price of $369. And it's made by RCA. So get the whole story about the surprising VP-3301 today. Write RCA MicroComputer Marketing, New Holland Avenue, Lancaster, PA 17604. Order toll-free: 800-233-0094.

**Model VP-3303 with *built-in* RF modulator—$389.
*Suggested user price. Monitor and modem not included.

RCA

CIRCLE 4

PERSONAL COMPUTING MAGAZINE

APRIL 1981 VOL. V, NO. 4

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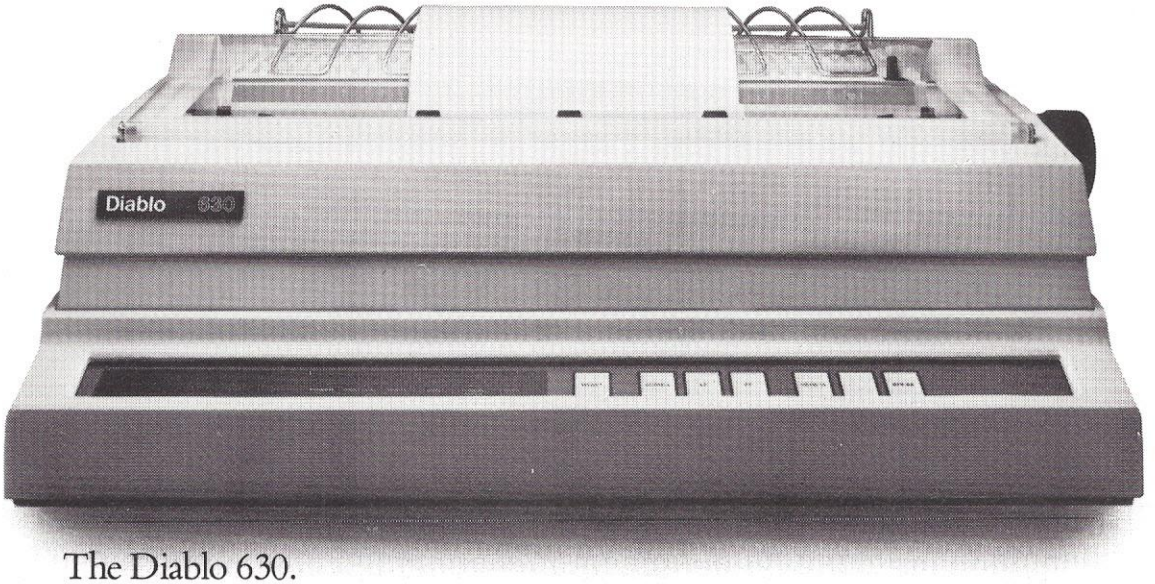
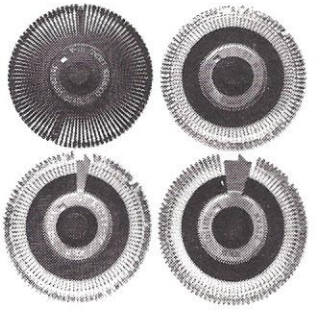


The Diablo 630.

It's the only printer that lets you use either metal or plastic print wheels. So you can choose the print wheel that's just right for the job.

The 630 works as well with a 96-character plastic daisy print wheel as it does with an 88-, 92-, or 96-character metal daisy print wheel. In over 100 different type styles.

Every 630 has fewer moving parts than competitive printers, which makes it more reliable. And it offers unsurpassed print quality. Compatibility with Diablo supplies. And bi-directional printing capability.



The 630 is the only printer in the world that uses both metal and plastic wheels.

So if you want to change your print wheels, you'll just have to change your printer.

To a Diablo 630 printer.

Diablo Systems

XEROX

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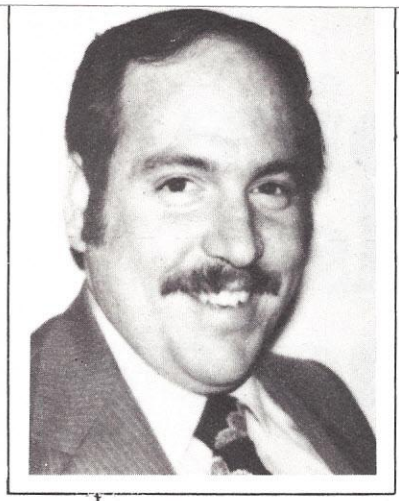

EDITORIAL

Software Piracy: The problem is getting worse

Piracy is as much a problem today as it was in the days of Captain Cook. The treasure of today's pirates, however, is not a chest full of gold or even jewels. It's computer programs. With the aid of today's personal computers, it is possible to take an under $2 floppy diskette and turn it into an object worth as much as $1500, and all in less than 2 minutes. It's no wonder that software piracy is as big a problem as it is today.

Software pirates come in two varieties: the money hungry steal-it-for profit pirate whose only interest is in seeing how much money he can make off of other people's labors, and the I'll-swap-you-this-program-for-that-program pirate, who doesn't see anything wrong with what he's doing. The former are easier to stop and prosecute than the latter who are by far the largest number of pirates. They give away and steal copies of other people's programs with sheer abandon, never thinking twice about the money they are stealing from the talented programmers who had the guts and foresight to invest countless hours in producing the program in the first place. Some of these modern day Captain Cooks even have the audacity to change a few lines of code and then relabel the program, claiming it as their own work.

The results of such actions has been inevitable, the price of software has gone up to compensate for these losses. Pirates counter the lost income claim by saying, "I wouldn't have bought the program anyway." If that's really true, then what do they need it for in the first place? A much worse result of the loss in income due to piracy is the loss of the good people who produced the programs. Having been discouraged by what happened to them in the personal computer marketplace, some of these talented people have gone to writing software for minicomputers, where the risks of being ripped-off are smaller. Also some talented business programmers from the minicomputer market have been scared away from the personal computer market because of piracy.

Software vendors have taken two approaches to the piracy issue. Some ignore it, hoping there will be enough of a market leftover to allow them to make a reasonable profit, but most develop protection schemes that make it very difficult to copy the software. Since nothing is 100% fool-proof, the first thing that is done when these non-copyable programs are released, is someone goes about breaking them. This forces vendors to come up with even more elaborate schemes and so the cycle goes on. The net result is that a lot of time and money is wasted, and the cost of software to the user goes up.

Unfortunately, by making it difficult for pirates to copy the software, the legitimate owners who went out and purchased the software are also prevented from making backup copies to handle unexpected emergencies. Some vendors tackle the backup problem by providing two copies of the program either upon purchase or after sending in a registration card. Others provide the backups at a nominal cost. Still others require that the original damaged disk be returned before a replacement is supplied. This is an inconvenience at best and unbearable for software used in the business environment.

The market for personal computers is growing and maturing. It's time that the users did too so that these foolish protection games wouldn't be necessary.

Jules H. Gilder
Editor

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Maxell offers a way to stay ahead.

A Maxell 5¼" Mini-Disk will consistently let you maximize the capability of your system today. And as your involvement with it grows, tomorrow as well. Maxell Mini-Disks are all made with the same exacting 100% certification and critical dependability of the Maxell 8" Floppy Disk. So you know your 5¼" Maxell Mini-Disks meet or exceed the same ISO and Shugart specifications industry requires.

There are double density Maxell single and double-sided 5¼" Mini-Disks for soft and hard sector systems. And 8" Maxell Floppy Disks for every disk drive configuration. See your computer supply dealer or write to us for more information. If you are a computer products dealer, write for the growing opportunities Maxell Business Products Division offers you with our 8" Floppy and 5¼" Mini-Disks.

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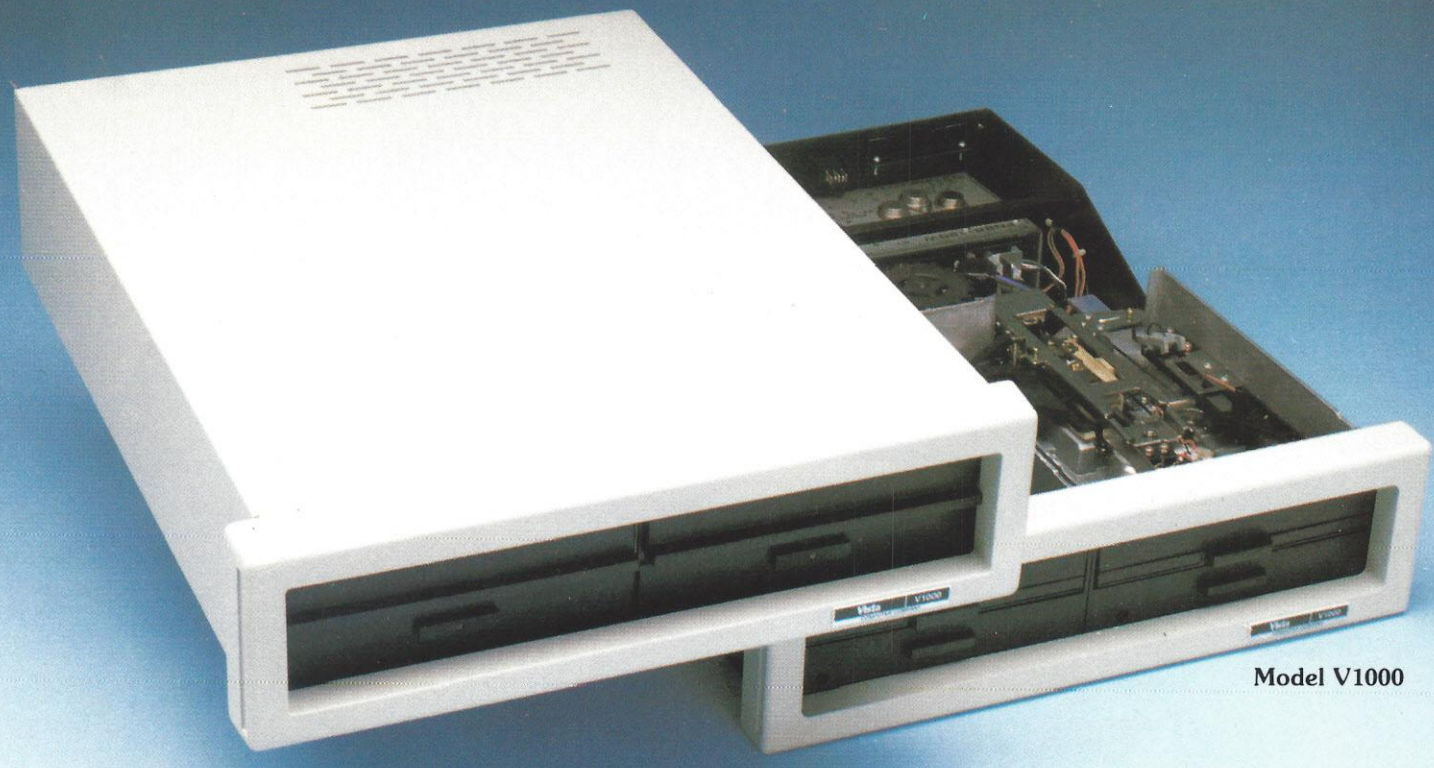
CIRCLE 6

Vista



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Eight Inch Floppy Disk Drive Subsystem Model V1000

The V1000, Vista's sophisticated new disk drive subsystem, sets new standards for ease of access and use. Its innovative design permits disk drives to be mounted or removed quickly and easily for system reconfiguration or servicing.

Features:

- Deluxe chassis with internal slide allows easy access.
- Storage capacity from 250 kilobytes to 2.5 megabytes.
- Desk or rack mountable.
- Accomodates both single-sided and double-sided drives.
- Industrial quality cabinet with die cast front bezel.
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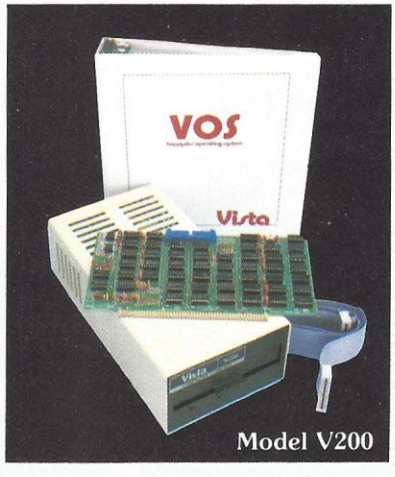
Cabinet with (2) single sided drives w/power supply	$1595.00
Cabinet with (2) double sided drives w/power supply	$2295.00
Cabinet (only)	$ 395.00



Model V200

Vista's Line of High Performance, High Reliability Products also Includes these Advanced Components

Daisy Wheel Printer Model V300

Features:

- 96-character proportional, bi-directional printing
- Interface - Parallel or RS232-C option

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Minifloppy Disk System, Model V200

Features:

- Storage capacity from 200K bytes to 1.2 megabytes
- Compatible with industry standard S100 main-frames.
- System software - Vista CP/M™ VOS Disk Operating System and Basic - E compiler.

Prices:

Starting as low as $695.00
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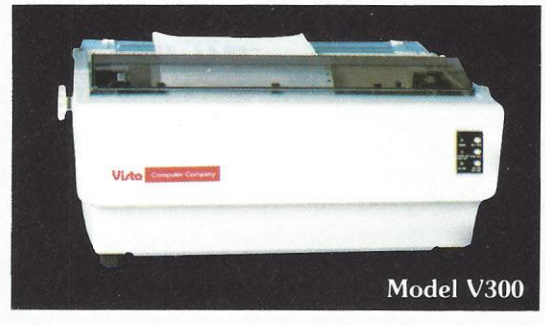

Model V300

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CIRCLE 7

FEEDBACK

Where the Line Numbers Came From

Dear Editors:

There is a mistake in my article "Where Does It All Go?" (February, 1981).

As printed it reads: "The line numbers which appear occasionally to the immediate right of the regular line listings are compiler-generated, and were not typed in when the program was written."

I'm not sure how it happened, but it should read: "The line numbers to the extreme left are compiler-generated, and were not typed in when the program was written."

The mistake may confuse readers not familiar with CBASIC.

Ray Vukcevich
Tempe, AZ

PIMS Mods

Dear Editor:

In your sidebar to the article on Data Base Management programs, you pan Scelbi's PIMS. PIMS is published in book form, not (usually) as a machine-readable program, and is not really comparable to some of the expensive programs in your article.

The reason that everything (sorting, search, resorting) takes at least 93 seconds (other than the sluggish operation of your TRS-80, of course) is based in the way PIMS stores records. Each record is stored in the single dimensional array R$. Fields within R$(X) are separated by ASCII 126, the "<". When considering a file operation which requires dealing with a single field, PIMS has no choice but to read each element of R$, parse that element, pick out the field that is of concern, toss away the rest of the record, and store the selected field together with the record identification number, in a second string array. In your example, this obviously takes about 93 seconds. This is obviously not an optimized system.

But PIMS has two great virtues. The first is that it does work. The second is that it is well documented with one statement per line, and 10 numbers between lines. This means that even to a programming illiterate (me), the program, once up and running, is easy to modify.

Over the past year, I have added many modifications to my version of the program, including the following:

- Relocating the parsing subroutine from high up in the program, and 5 or more lines, to lines 11 and 12 (multiple statements per line are permitted on my Apple, of course);
- Changing from a system of sequential records, with the entirety filed always in RAM, to random-access fixed length files, with only one record at a time in RAM;
- During a sort, exchanging only the sorted field, not the entire record;
- Dividing the program into chained modules, so that memory-consuming tasks, such as sorts, have more room to work.
- Creating separate disk files which contain the most often accessed fields, thus minimizing the need for parsing at all;
- Substituting a machine language sort (Ampersort, in my case) for the BASIC-modified Shell-Metzner sort;
- Linking the "illegal command" routine to the HELP command, so that a list of possible commands are printed on the console if you issue an invalid command.

As you can see, none of the above are startling innovations, but combined, they make PIMS extremely efficient for small data bases. In other words, don't buy PIMS if you want a powerful turnkey DBM program. (On the other hand, PIMS, as written here, has error-trapping routines and does not crash when you specify a file not present on disk, as does one $150 system I have seen.) DO buy PIMS if you want an easy, cheap, expandable, modifiable system, and a good place to learn about how to handle data.

Barry D. Bayer
Homewood, IL

Data Base Input

Dear Editors:

You are to be complimented for your February lead: "How to Choose Data Base Management Programs." Speaking as one of the CCA Data Management System authors, I think Fred Blechman and Jules Gilder surveyed this broad topic fairly, objectively and intelligently.

I would, though, like to correct several inaccuracies in the remarks about the CCA DMS. The TRS-80 Model 1 version does in fact have random access, using record number, and indeed complete instructions for loading the cassette tape *are* provided in the manual. The CP/M versions allow record sizes to 3060 characters, and Vector Graphic markets a CP/M version of CCA's DMS that is customized to their hardware features.

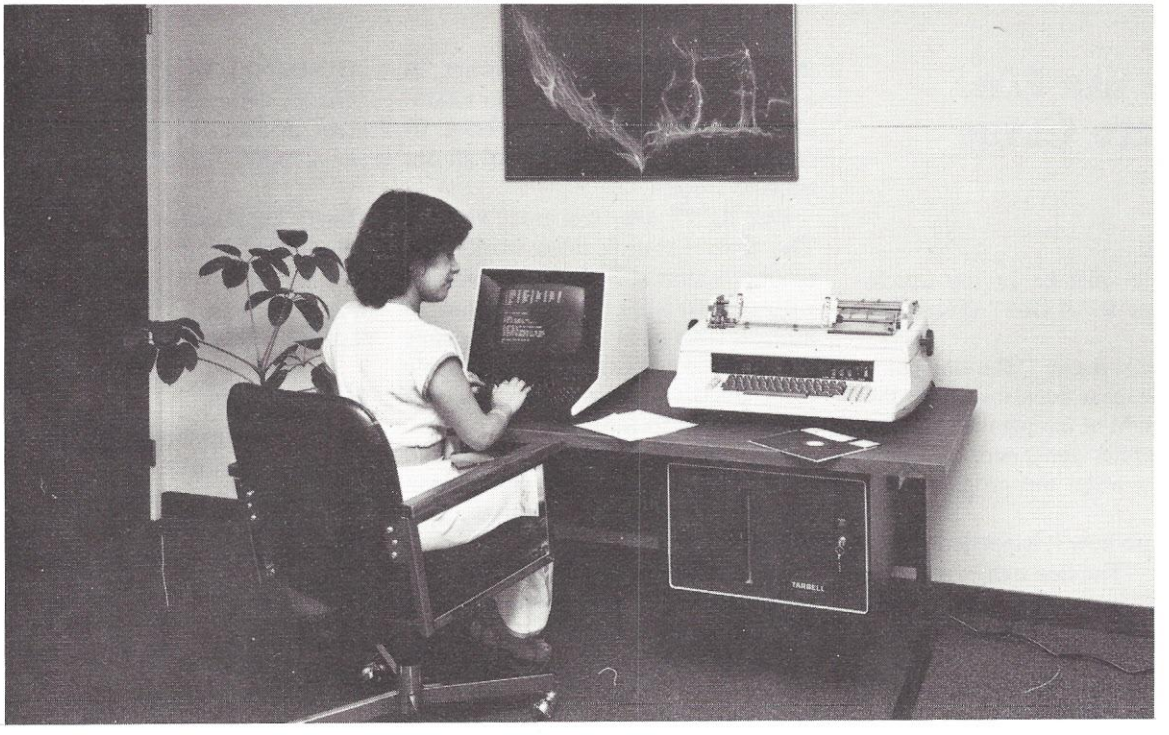
Also, the article did not mention that all CCA DMS versions have a powerful 5-function computation feature for numerical data.

One topic that the authors did not review was that of user support, after the sale. Personal Software deserves high marks in this area, as they staff a "hot-line" for the Apple and TRS-80 Model 1 versions, and have issued, at no cost to registered owners, revised software and documentation to insure trouble-free use. CE Software and Vector Graphic also maintain a positive commitment to user support.

I hope this information will be useful addenda to the buyer who is using the article for comparison shopping.

Chet Floyd
Manhattan Beach, CA

Move Up to Tarbell



The Serious Business Machine

Do you have a small computer system that operates with mini-floppies and has limited storage capacity? Then it's time to move up to the Tarbell Empire Series System. Tarbell starts where small systems leave off, providing storage from 1 to 20 megabytes. This means Tarbell is capable of growing right along with your business. (It also makes sense to start with Tarbell if you're a first-time computer buyer.)

Tarbell is the serious general purpose business machine, backed by years of experience with disk systems. It gives you word processing, inventory control with bill of materials, mailing lists — all in addition to accounting applications: general ledger, payables, receivables, payroll with cost accounting and order entry. Whatever your need may be, Tarbell can provide the working software that gets the job done.

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CIRCLE 8

RANDOM ACCESS

Computer Aids Pastor With Congregation

An Alhambra, California pastor credits his microcomputer with making it possible for him to support a leap from a local congregation of 200 families to a nationwide audience of an estimated 750,000.

Pastor Ian Robertson, of the Alhambra Church of the Nazarene, came to his 60-year-old suburban Los Angeles congregation at a time when church membership stood at 200 families. Last April, he began a religious program on three television stations in Los Angeles and San Francisco. Now the program is beamed by satellite to 300 cable TV stations in 39 states and is reaching a viewing audience estimated at three-quarters of a million people.

When the possibility of the television program first came up, Pastor Robertson realized that the volume of mailings needed to produce income required to sustain such a series would be too great to be handled by church volunteers. A microcomputer sounded as if it might offer the answer to the mailing problem. And it has, he says. The size of the mailing list and the volume of letters that go out to each viewer who writes and makes this kind of effort unmanageable without a computer, the Pastor believes. "Our mailing list increased from 500 to 5000 in the first six months," he said. "And I wouldn't be surprised if the number reaches 20,000 after a few months on the satellite."

Pastor Robertson tried working with a system belonging to one of his parishioners, but it proved unsatisfactory because it took too long to sort a mailing list.

A computer trade show in nearby Los Angeles offered the Pastor an opportunity to look over the entire line of small business systems. He found that equipment from Vector Graphic seemed to provide the needed capacity, word processing software, the capability to sort and process a large mailing list, and the ability to merge text with the mailing list for personalized letters. "The cost of the microcomputer with the peripheral equipment and programs we needed was about $8000," Pastor Robertson said.

Pastor Robertson supervises the preparation of his mailing list with Diane Hernandez.

To insure that his decision was sound, Pastor Robertson arranged to try out the Vector Graphic computer at the dealership in his area, Personalized Computer Systems in Arcadia. It was an unusual arrangement, but the pastor spent hours working with the system, took the manual home to study overnight, and brought in typical projects to run. Within a month, according to the dealer, the Pastor had taught himself how to use the computer and had become convinced that it would be suitable.

The equipment he settled on consists of the Vector Graphic System B, a desk-top microcomputer built around a video display screen. The microcomputer has 56K RAM, two floppy disk drives and a high speed, letter-quality line printer.

Pastor Robertson produces the church's monthly 16-page magazine on the computer by first writing the copy in draft form directly on the Vector display terminal. After he makes his own corrections, the copy is edited and put into finished form by his secretary, Diane Hernandez. She then selects type styles and sizes, and prepares a layout. Formerly, the copy would then be hand-carried to the typesetter. Now, however, Hernandez places a phone call to the typesetter and feeds the newsletter copy automatically over the phone directly to the print shop's computer which sets the type in reproduction form.

The microcomputer is also used to prepare the quarterly Sunday School class records. In the past it took Hernandez three full days to update and correct these records. She now does the job on the Vector in 1½ hours.

In addition to the variety of word processing functions, the church has recently obtained general-ledger software and is currently transferring all bookkeeping functions to the computer.

Based on his own experience to date, Pastor Robertson is convinced of the value of the microcomputer in a church setting, and certain that other ministers will soon recognize the benefits. "It's the first time I've really been sold on something this way," he said. "We've had no problems and no down time."

Job Explosion in Computer Industry

Robert Terzi does a brisk computer programming business in his Garden City, NY neighborhood for a group of local business firms. Robert is 15 years old. The demand for Robert's services (he has up to 10 steady customers) dramatizes the fact that while people in other occupations are besieging employment offices for work, those in computer-related fields are being welcomed with open arms.

According to "Computerworld," an industry weekly, an employment forecast for 1981 states that there will be "an ever-growing demand for virtually anyone with any type of DP (data processing) skill."

A survey undertaken by Dunhill Personnel System, a national network of approximately 300 recruiting offices, envisions a 15 to 20% shortage of programmers this year, and twice that for applications personnel. "People who are fortunate enough to work in computer-related businesses," says Dunhill's president, Robert E. Kushell, "are today, kings of the hill. And things are going to get steadily, and rapidly, better for them."

Industries that offer big opportunities for data processors, now and even more in future years, are those in the energy sector, according to Kushell. He cites U.S. Labor Department projections indicating a 90% increase in jobs in the oil and mining industries. Government on all levels is also a fertile field for data processing specialists, with an expected employment increase of nearly 80% by 1990. Big increases are also projected for real estate, insurance, construction, manufacturing and wholesale and retail firms.

"According to government employment forecasts—arrived at, of course, by computer—jobs in this field will increase more than 80% by the end of this decade. This is four times the projected growth rate for all occupations," Kushell said.

For individual job categories, the projected growth rate is more than 150% for service technicians, about 120% for systems analysts, and over 100% for programmers and operators.

One of the reasons for the unprecedented demand for help in the industry is the extension of computer use to small businesses and even homes. This is the factor that opened opportunities for young Mr. Terzi, who, despite his youth, is highly regarded by his clients, and has lectured on computer technology.

The lag in trained personnel to man equipment now in place is a major concern for many businesses that have made substantial investments in hardware and software. Another concern is that not enough people are currently enrolled in data processing courses at universities and other training institutions to keep up with the workforce demand. According to Kushell, a part of this stems from the fact that educators are being lured away by substantially higher salaries offered by corporations and producers of computer software. "A less tangible factor, but nevertheless an important one," Kushell said, "is that unlike old established 'prestige' professions, such as medicine and law, the computer field is still too young to have what might be called a 'family tradition' for those growing up to follow."

To solve the problem of staffing, many companies are now turning to in-house training programs. One important advantage of this is to keep the employees up to the minute on the company's particular methods and state-of-the-art equipment. A recent development in the industry is the emergence of "contract" programmers, freelancers who hire themselves out on a project basis and, when the job is done, move on to another company or assignment.

Computerized Jury Selection

Say farewell to "professional" jurors, those people whose friends at the courthouse favored them with frequent calls for jury duty. They're already gone from most of the nation's federal district courts where jurors are selected by computers instead of by cronies. And, increasingly, they're passing from the scene in county courthouses where clerks, if not employing computers, are using random selection of jurors by taking every 10th or 12th name from voter registration or tax lists.

"I couldn't pick you for jury duty if I wanted to," says W. Farley Powers, Jr., clerk of the U.S. District Court for Eastern Virginia. Powers' court was among the first in the nation to turn to computer selection of jurors. Now, he points out, 70 of the nation's 96 federal district courts call upon computers—which are often hundreds of miles away—to make up lists of jurors and, in some instances, issue summonses and pay vouchers.

Administrative offices of U.S. courts have been "emphasizing" computerized selection, Powers said, because it's faster, cheaper and "a less personal way of selecting juries." Before his court turned to computers, Powers hired four college students to pour over voter registration books, club and civic league membership lists and telephone directories to compile a list of prospective jurors. "The computer does in three days what it took the college kids and my staff three months to do. By and large, it's a beautiful system," Powers said.

Every two years, Powers buys a computer tape with the names of every registered voter in Eastern Virginia from the secretary of the State Electoral Board in Richmond. A General Services Administration computer in Washington, D.C. is programmed to select at random the names of prospective jurors who then are sent questionnaires to de-

termine their eligibility to serve. About half of the prospective jurors in Eastern Virginia qualify to serve for a four-month period; the others are exempted because of occupation, address change, physical condition and other circumstances.

When there's a need for jurors, Powers' chief deputy, Ray Old, goes to Washington and orders the GSA computer to print up a list of qualified jurors who will then be summoned to court. Under this system, Powers said, the earliest a person can be called for jury duty again is two years.

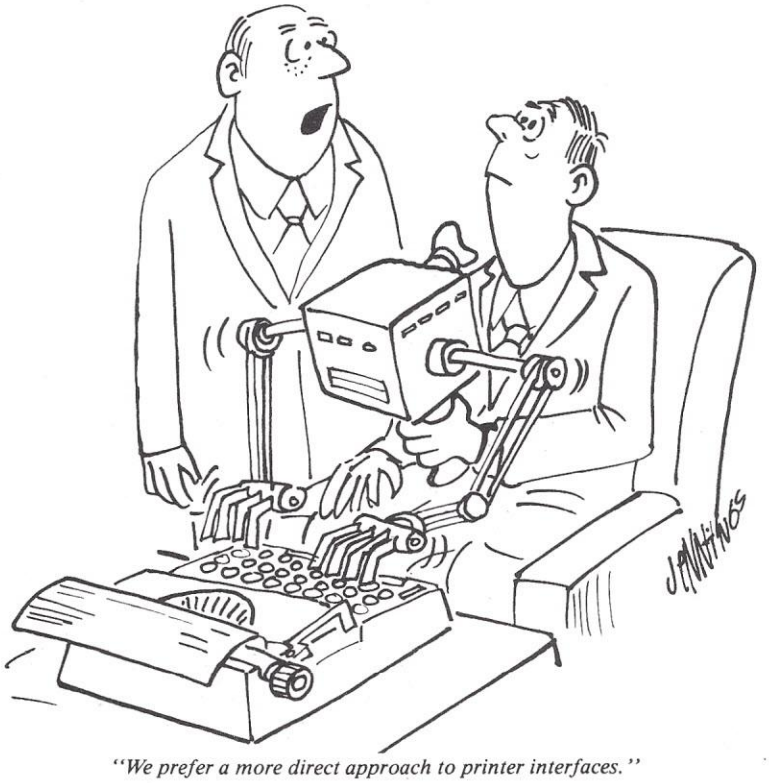
Some states, according to Chester H. Mount at the Center for Jury Studies in McLean, Virginia, are going the federal courts one better by sending out computerized qualification questionnaires and summonses at the same time. "If the person is not qualified, he doesn't have to come to court," says Mount. And in at least one state court—Montgomery County, Maryland—jurors serve only for one day or for one trial and get paid in cash at the end of the day.

State courts are "getting away from the country club list and going to more recognized lists like the voter registration list," Mount added. "If they're not using computers, they're using random selection." In 14 states, however, clerks of court or jury commissioners still use their discretion at how jurors are picked and in these areas the "professional" juror can still be found.

Indeed, not too many years ago, Powers says, his father was called regularly to serve on state court grand juries in Norfolk because he was a prominent citizen and well-known at the courthouse. Such practices are open to attack, especially by civil rights lawyers, because there is not a good mix of races and people of different socio-economic backgrounds, Powers said.

Computerization, too, is making curiosity pieces of the little wooden boxes and barrels where the names of prospective jurors were placed to be stirred around and ceremoniously drawn in open court. Powers has two in his office in the Norfolk Division of U.S. District Court. He plans to keep them for a small museum he's building in the courthouse.

—by Carl Cahill



"We prefer a more direct approach to printer interfaces."

All-Purpose System Emerges

The small business system, personal computer and word processing markets for disk drives are rapidly disappearing as distinct entities, converging into a market for all-purpose computer systems at the stand-alone and desk-top levels, George Sollman, Vice President of Marketing for Shugart Associates, said. Sollman spoke on "Trends in Rotating Storage Technologies" at the third annual conference on Integrated Office Systems.

During the last five years, Sollman said, "most observers described the markets for low-cost data storage as personal computing, small business systems and word processing. By 1981, these market segments have converged into one another."

"The personal computer market is a long way from meeting early expectations that it would explode into a vast home computer market. Based upon market entries today, it already appears to be nearly saturated," Sollman said. As a result, many "personal computer" suppliers have successfully exploited segments of both the word processing and small business markets.

In the word processing area, Sollman said, a similar pattern is taking shape. "The trend is to reduce the differences between word processing systems and small business computers, so that they are differentiated primarily by operating systems and applications software."

"What we see emerging," he said, "is the demand for an all-purpose computer system at two major market levels: stand-alone and desk-top units." These two systems are distinguished more by physical size than by end-user application, Sollman said.

Sollman also called computer networking a "major new factor" in the low-cost rotating storage market. "Network links will include both stand-alone and desk-top systems," he said, "boosting the prospects for all types of local peripheral storage."

While the 8-inch floppy drive continues to be the standard for data inter-

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Modular Software Assoc; tape $19.95, disk $29.95

Level II Tapes

'Tiny' Pascal runs on any 16K Level II system, includes the programming structuring capabilities of full Pascal, but not data structuring.

Able to compile Z-80 machine code, programs run about 5X faster than Level II Basic—graphics run eight times faster! Requires use of T-Bug (or Tape 7) and ETASM
Tape 3, People's Pascal $19.95

Tape 1, 34 buis., edu., game progs. $10.95
Tape 2, 77 programs from Osborne book: Some Common Basic Programs $10.95
Tape 5, 24 buis., edu., game progs. $10.95
Tape 7, 31 buis., edu., game progs. $10.95
Tape 8, 40, inc. 4X tape speedup $10.95
Tape 9, 25 buis., edu., game progs. $10.95
Tape 10, income tax, checkg act $10.95
People's Taxman, fills-out all forms $10.95

PASPATCH

PasPatch, Tape 6P, makes Tandy tiny Pascal a **powerful disk system!**
Modular Software Assoc. $15.95

SuperPIMx—People's Database

PIMS has been greatly speeded up and simplified, with machine-language sorts, key debounce, optional automatic lowercase (no keying, no **fields, limited by 255-character maximum per field.** limited by 240-character maximum per record. Easy to revise, add records, split or merge files, sum or average any fields. Customized for tape, tape & disk, Zoom, TC8 Poor Man's Floppy, B17, Stringy Floppy—all on one tape! As mailing labels program, easily manages 20,000 list. CIE does! Advanced labels module to come, $24.95, making system most powerful mailer available!
program (CIE) **$19.95 ($21.15 CA)**
book, details uses (CIE) $11.95 ($12.67 CA)

Tiny Payroll

We've taken it from **Computer Programming for the Complete Idiot**, thus a whole book of documentation! For all above systems.
CIE $10.95 (CA $11.61)
Book, documents Tiny Payroll $5.95

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Modular Software Assoc. tape contains:
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Word Processing Newsletter

Want to really USE your computer? Then word processing is for you. Let your computer show you how much easier writing can be.

Learn about the new 510 cps 'non-daisy' that at 10X daisy speed gives correspondence quality, at less than twice the cost. Too slow? The really fast guys are coming. How about 30 11x14 typeset-quality documents per minute? Maybe you could use the same 'printer' as a copier.

How about an inexpensive ($169) magnetic card reader-writer that would let you input mail addresses, letter paragraphs, even small programs?

Read about all this and more in **Low Cost Word Processing**, the only newsletter about word processing using your personal computer. Just $15 for 12 issues.

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CIRCLE 9

change in stand-alone systems, the current 5¼-inch minifloppy drive is the workhorse of desk-top systems, according to Sollman. He predicted that with their new 96 track-per-inch densities, minifloppies will make possible low-cost desk-top systems with storage capacities formerly available only in larger stand-alone units.

Sollman also discussed the newest technique being used to develop low-cost rotating storage—the optical disk. Because the optical disk medium is, at present, non-erasable, he said, this laser-based technology is likely to find its initial applications in archival storage. He concluded that this new technology "Promises to increase the capacity of low-cost disk storage a hundredfold."

Portable Terminal Industry Entering New Era

Competition in the markets for handheld and briefcase terminals will be intense during the next five years, with new vendors such as Tandy, Apple, IMB, DEC and Sears expected to enter the marketplace. However, current indicators point to a market that is expanding rapidly enough to permit success by many participants, according to an analysis of the portable terminals industry released by Creative Strategies International (CSI), a market research and consulting firm.

A portable terminal is defined by CSI as a handheld or briefcase terminal with the following characteristics: some type of communication capability; costing less than $10,000; and used primarily for business applications.

CSI forecasts worldwide revenues for these terminals of nearly $900 million by 1985, a compound annual growth rate of 31.5%. A closer look reveals that the growth rate for foreign revenues will be considerably higher as many U.S. vendors make a concerted effort to penetrate overseas markets.

Within the portable terminal market are two major segments: handheld and briefcase terminals. A handheld model has all of the aforementioned portable terminal characteristics, as well as the ability to be held in one hand or cradled in one arm, while the other hand operates the terminal. A briefcase unit is a portable terminal that weighs under forty pounds, and, when fully configured, fits within its own carrying case with handle.

Traditional applications, including order entry for inventory replenishment, currently account for over three-quarters of the market for handheld units, but this percentage will see a dramatic decrease by 1985. One of the largest new markets is in the area of route accounting. Major handheld vendors are marketing units in the soft drink, dairy, liquor, tobacco, and pharmaceutical distribution field for regular sales and delivery routes.

CSI expects an even more dramatic growth rate for handheld terminal revenues through 1985. The increasing popularity of higher-priced programmable units as well as overall growth in unit shipments will be responsible for this rapid increase.

The 1980's is also the beginning of a more extensive type of briefcase function—distributive data processing. Terminals are being manufactured that are effectively self-contained, programmable microcomputer systems with internal, as well as removable storage. Presently the majority of end users of these products are engineers or specially-trained programmers in the areas of field analysis and testing. But CSI expects this end-user configuration will change significantly in the future as new industries, such as insurance and real estate, become fully automated.

Increased competition and new technological developments will result in substantial price decreases for non-intelligent, smart, and microcomputer-based briefcase units during the forecast period. Despite these lower prices, revenues for this market will more than triple by 1985.

Computer Information Network Available In 29 States

A national information network of over 100 small computers, with equipment valued upwards of one million dollars, is now in operation in 29 states and the District of Columbia. These computers can be accessed, free of charge, by anyone with a computer or terminal, a telephone and a modem, according to Bayard Kessler, president of Novation, Inc.

Specialized information on medicine, photography, astronomy, education, amateur radio and so forth, can be transmitted to any other computer or terminal by using an ordinary home or business phone and an inexpensive electronic phone coupling unit, a modem.

California, with 28 free computers, leads all other states in the listing. Illinois is second with 10, and New Jersey, Washington, New York, Missouri and Massachusetts tie for third with five computers each.

The list of computers that form the new public access network was gathered over a 10-month period by Novation. Computers were selected for the quantity and quality of data offered. All systems provide interesting information, news, features and computer data. Some offer a selection of electronic game playing and several systems will send callers free computer programs as well. Many computers provide special interest information, and data files are dedicated to a specific subject.

According to Kessler, all computers are free of charge and most do not have time limits. The only costs are for long distance or toll line phone charges. Most computers are available evenings or week-ends when phone rates are the cheapest, and 38 computers normally operate 24-hours a day, seven days a week.

The computers are operated by user groups, schools, publishers, commercial businesses and hobbyists. All costs are paid by the owner/operators.

All computers in the list can be accessed using a 300-baud, asynchronous modem that is compatible with Bell System 100 series specifications. For more information, contact: Novation, Inc., 18664 Oxnard St., Tarzana, CA 91356; (213) 996-5060.

★★★ Announcements ★★★

Educational Courseware

Educational Solutions, an educational research and development organization in New York directed by Dr. Caleb Gattegno, recently received a grant from the National Science Foundation for the development of microcomputer courseware for teaching numeration, addition and subtraction. This approach to mathematics is based on learning through insight and practice rather than learning through memorization and drill, the company said.

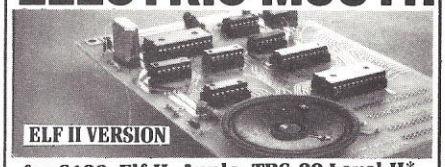
Learners are engaged in activities based on perception. The activities enable the student to control operations which parallel the set of mental operations required by numeration, addition and subtraction. Feedback helps guide and refine the student's growing insight; practice transforms this insight into functional skills.

Under the provisions of the grant, Educational Solutions will first produce the courseware in prototype form and then test it with learners of various ages in public schools. After the results of the field testing are analyzed, the courseware will be revised and prepared for distribution.

For more information, contact: Educational Solutions Inc., 80 Fifth Ave., New York, NY 10011; (212) 924-1744.

(*continued on page 79*)

NEW!!! THE ELECTRIC MOUTH*



for S100, Elf II, Apple, TRS-80 Level II*

From $99.95 kit

Now — teach your computer to talk, dramatically increasing the interaction between you and your machine.

That's right: the ELECTRIC MOUTH actually lets your computer talk! Installed and on-line in just minutes, it's ready for spoken-language use in office, business, industrial and commercial applications, in games, special projects, R&D, education, security devices — there's no end to the ELECTRIC MOUTH's usefulness. Look at these features:

- ★ Supplied with 143 words/letters/ phonemes/ numbers, capable of producing hundreds of words and phrases.
- ★ Expandable on-board up to thousands of words and phrases (just add additional speech ROMs as they become available).
- ★ Four models, which plug directly into S100, Apple, Elf II and TRS-80 Level II computers.
- ★ Get it to talk by using either Basic or machine language (very easy to use, complete instructions with examples included).
- ★ Uses National Semiconductor's "Digitalker" system.
- ★ Includes on-board audio amplifier and speaker, with provisions for external speakers and amplifier.
- ★ Adds a new dimension and excitement to programming; lets you modify existing programs and games to add spoken announcements of results, warnings, etc.
- ★ Installs in just minutes.

Principle of Operation: The ELECTRIC MOUTH stores words in their digital equivalents in ROMs. When words, phrases, and phonemes are desired, they are simply called for by your program and then synthesized into speech. The ELECTRIC MOUTH system requires none of your valuable memory space except for a few addresses if used in memory mapped mode. In most cases, output ports (user selectable) are used.

Spoken Material Included

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two	nineteen	cancel	down	is	of	second	d u
three	twenty	case	equal	it	off	set	e v
four	thirty	cent	error	kilo	on	space	f w
five	forty	400hertz tone	feet	left	out	speed	g x
six	fifty	80hertz tone	flow	less	over	star	h y
seven	sixty	20ms silence	fuel	lesser	parenthesis	start	i z
eight	seventy	40ms silence	gallon	limit	percent	stop	j
nine	eighty	80ms silence	go	low	please	than	k
ten	ninety	160ms silence	gram	lower	plus	the	l
eleven	hundred	320ms silence	great	mark	point	time	m
twelve	thousand	centi	greater	meter	pound	try	n
thirteen	million	check	have	mile	pulses	up	o
fourteen	zero	comma	high	milli	rate	volt	p
fifteen	again	control	higher	minus	re	weight	q
sixteen	ampere	danger	hour	minute	ready	a	r
seventeen	and	degree	in	near	right	b	s

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- ☐ **Apple "Electric Mouth" kit $119.95**
- ☐ **TRS-80 Level II "Electric Mouth" kit..... $119.95**

Add $20.00 for wired & tested units. All plus $3.00 postage & insurance. Conn res. add sales tax.

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Signature _____ **Exp. Date** _____

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CIRCLE 10

WHAT'S COMING UP

SYSTEMS

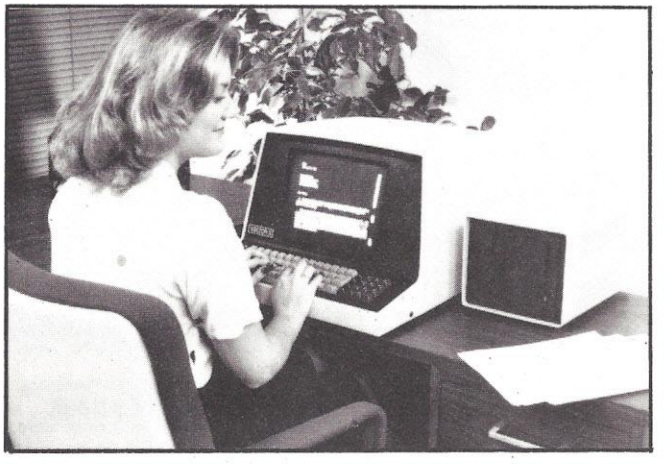
Desk-Top Business System

A desk-top business data and word processing system with the speed, capacity and reliability of Winchester hard disk storage has been introduced by Vector Graphic, Inc.

The new information system is the Vector 3005. For approximately $7950, it includes a 5¼ inch five megabyte Winchester, a 630 kilobyte double-sided, quad-density floppy disk, Vector 3 display terminal and keyboard plus an array of Vector software.

The disk stores a file of up to five MB or 256 different files, about twice the capacity of the Vector 2800. A single hard disk can store a mailing list of up to 3700 names and addresses.

A Dualmode controller board controls both the Winchester and the floppy disk drives. It is the key to the 3005's error-correcting capability, the company said. Based on IBM-type technology, it automatically corrects up to five erroneous bits in every 256 bits, eliminating errors due to disk contamination, aging, surface defects and all but the most severe disk damage.



The error-correcting scheme also operates on floppy disk data. Since the floppies are used for Winchester back-up, the error-correcting feature adds to the 3005 system's overall reliability and integrity, according to Vector Graphic.

Track-to-track access time of the Winchester is three milliseconds; the companion floppy disks also have three millisecond track-to-track access time. Both the Winchester and floppy drives are housed in a compact unit approximately 8 × 6 × 12 inches which fits on a desk-top adjacent to the 3005's display terminal.

The disk controller also features 256-byte sector buffering, making the 3005 useful for communications and other real-time functions since the buffering enables the CPU to simultaneously handle interrupts and data transfers in and out of memory, Vector said.

All Vector Graphic software, including the recently-announced Memorite™ III advanced word processing and ExecuPlan™ financial planning packages, operate on the new 3005, making it possible for a user to easily upgrade to the new disk-based system or to mix various Vector systems in a single installation with complete freedom of software exchange.

Prime users of the 3005 will be accounting, insurance, financial consulting and other small businesses which need the added capacity provided by the disk, as well as the growing number of self-employed professionals who need maximum productivity at minimum cost, Vector predicted.

Although most Vector systems are installed in offices, there are a growing number of users who want to operate the equipment in a factory, dusty or other severe environment. The 3005, with its contamination-proof hard disk, would be ideal for such applications, the company said.

Either a Sprint 3 daisywheel or MP dot matrix printer can be ordered for use with the 3005 system.

Software provided with the Vector 3005 includes the CP/M-2 operating system, SCOPE editor, RAID debugger, ZSM assembler and Microsoft Basic 80. Options are Peachtree business accounting office software and Vector's Memorite III word processing and ExecuPlan financial planning software packages.

More information on the Vector 3005 information system with Winchester disk storage is available from Vector Graphic, Inc., 31364 Via Colinas, Westlake Village, CA 91362; (213) 991-2302. *Circle No. 101.*

Disk Based System Available for PMC-80

The PMC-80 now has an Expander, Model EXP-100, which provides 32K memory expansions, mini-floppy disk interface for four drives, Centronics parallel printer interface, RS-232 interface and an S-100 bus to provide additional interface capabilities.

With the availability of the Expander, the PMC-80 compu-

ter is capable of a number of configurations ranging from a simple Level II tape based system to a fully implemented word processing or business system utilizing the same software as was developed for the TRS-80 Model I computers.

The PMC-80 with the EXP-100 Expander will run TRSDOS software as well as other operating systems designed for TRS-80 compatibility such as NEWDOS and VTOS, the company said. Software and operating systems are available from Radio Shack and many independent software companies.

The S-100 bus in the Expander permits the addition of 16K or 32K memory boards and the 16K memory board is expandable to 32K. Other S-100 boards available from independent hardware vendors may be plugged into the Expander to provide special features not readily available to TRS-80 users.

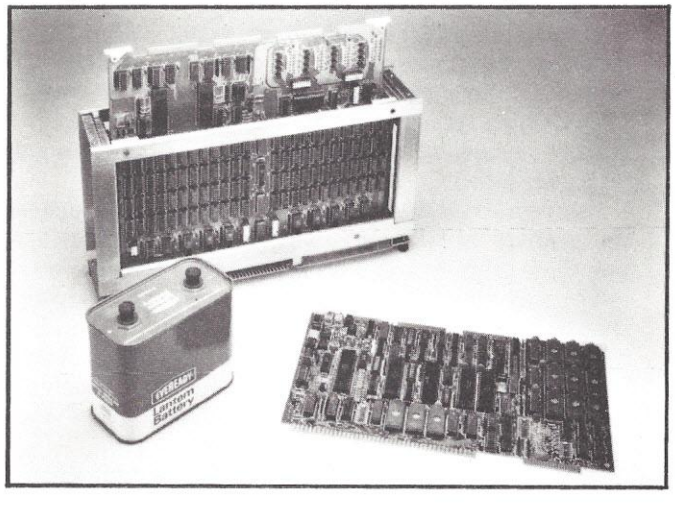
Personal Micro Computers has also introduced a plug-in printer interface (Model PIF-40) for the basic PMC-80 computer. The printer interface permits any printer with a Centronics compatible interface to be connected to the PMC-80 without the need for the Expander. The PIF-40 also provides a 40 pin TRS-80 interface connector which permits various TRS-80 compatible peripherals to be plugged into the PMC-80. A typical application for such a configuration would be a communication terminal for connection to one of the micro timesharing service facilities. The only additional hardware required would be a direct connect modem.

Price of the Expander, Model EXP-100, is $410 without memory and an additional $245 for 16K or $295 for 32K memory board. The PIF-40 printer interface is listed at $95. Both the EXP-100 and PIF-40 are now available for delivery and require a $25 cable for connection to the PMC-80.

Additional information is available from Personal Micro Computers, 475 Ellis St., Mountain View, CA 94043; (415) 962-0220. *Circle No. 102.*

All CMOS Microcomputer System

Pacific Cyber/Metrix, Inc., has announced availability of a complete all-CMOS microcomputer system. Designated the Model PPS-12, the compact system employs a IM6100 CMOS microprocessor and has been specifically designed for data acquisition and control applications in the field where only battery and/or solar power are available. Only five volts are required for operation and most system configurations will require less than one-half watt of power.



The CPU module, which includes three parallel I/O ports, one optically-isolated 20mA/RS-232 serial I/O port, a programmable real-time clock, 4K words of CMOS EPROM/RAM memory, a memory expansion controller and a powerful on-board transparent monitor/debugger, is also supported by over a dozen system expansion modules, including several parallel and serial I/O modules, memory expansion modules, an all-CMOS analog-to-digital converter, and power-switched bubble memory for mass storage, the company said. All modules are built on MULTIBUS card dimensions, and can be plugged into any standard MULTIBUS card cage.

The 12-bit 6100 microprocessor employs a binary instruction set identical to that of Digital Equipment Corporation's PDP-8 and VT-78 DECstation minicomputers, so software development can be carried out on any of these machines. Alternately, PC/M makes available its 6100-based Omega microcomputer in a configuration that is fully integrated with the PPS-12 system to facilitate software development in the laboratory. The company's Model 660 CMOS-EPROM Programmer is also available for programming the 6653 CMOS eraseable PROMS used in the system.

Price for the PPS-1201 CPU module is $999; delivery is 30 days. For more information contact Ted Natoff, PC/M, Inc., 6800 Sierra Ct., Dublin, CA 94566; (415) 829-8700. *Circle No. 103.*

PERIPHERALS

Modification Turns 80-Column TI Portable Into 132-Column Terminal

A new, easy-to-install modification, the Texprint 132, turns the standard 80-column TI 743/745 into a 132-column portable terminal.

A two-step modification allows the "normal" 80-column TI 743 or 745 to print 132 columns: a simple replacement of the socketed microprocessor with a small printed circuit board, and changing the motor pulley and cable. These changes are fully reversible, permitting the terminal to be reconfigured as original. Needing only a small screwdriver and the Texprint 132, the enhancement operates via the TI terminal on standard 8½" paper width. The choice of 80 or 132-column operation is code-selectable.

In addition to providing 132 columns of print positions, the Texprint 132 presents output in much more readable form, the company said. Eighty column printing on the TI 743/745 is in a 35-dot matrix and 5 × 7 format. At 10 characters-per-inch, each character is 0.105" high × 0.08". wide. This contrasts with the Texprint 132 version which, in the same 35-dot matrix and 5 × 7 format, presents letters at the same height, but only 0.048" wide. Therefore, 15.6 characters-per-inch are printed, producing clarity and easy

continued on page 73

Disk Memories: What You Should Know Before You Buy Them

BY DAVE BURSKY

Selecting a disk drive to increase the storage capacity of your computer system can be a confusing experience. Esoteric terminology, specifications that appear to differ only in milliseconds, arguments over the floppy disk vs. the hard disk and a host of other considerations make it difficult to be sure you're judging the options properly.

Relax. There are six essentials to consider: storage capacity, storage speed, backup methods, transportability, system availability and price. Much of the confusion will be stripped away when you analyze disk drives by checking these basics.

Begin by asking yourself: How much storage will my system need in the next 12 to 24 months? How fast should that storage be? Must the storage media be transportable (do I want to remove it to insert it into another drive)? Do I need a backup storage system to guarantee data retention in case of media failure? What method will I use to load new programs into the system? How much do I want to spend?

Capacity is a key factor

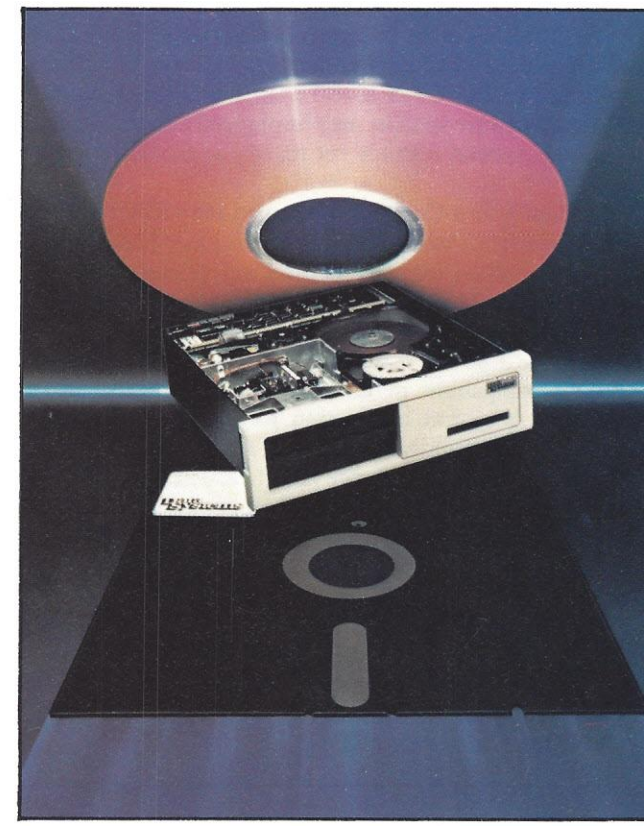
Storage capacity is probably the single most important consideration. It is the amount of information a disk will contain without replacement in the drive. Floppy disks offer storage that ranges from 80 kilobytes (80,000 characters) to 3 megabytes (3 million characters). Hard disk storage can range from 1.8 megabytes to over 600 megabytes.

For most personal and small business computer systems, mini-floppies (5¼-inch diskettes), full-sized floppies (8-inch disks) and 8-inch hard disks using Winchester drive technology are the most commonly used disk storage systems. Let's consider the floppies first.

Floppies are Mylar disks coated with a magnetic oxide. Information is stored on the diskettes in the form of 0s and 1s, which are represented by oxide particles magnetized in one of two opposite directions. Disk drives introduced in the early 1970s used only one side of a floppy disk for data storage, but these soon gave way to units that could read and write information on both sides of the disk, thereby doubling storage.

A floppy disk, regardless of its size, is encased in a nonremovable plastic jacket that protects the disk from dust, fingerprints and other contaminants that could damage the Mylar surface. The jacket, however, does not cover the entire disk. There are a number of openings in the casing, and these are vulnerable to contamination that could damage the disk surface and result in loss of data.

Dave Bursky is a senior editor for Electronic Design Magazine.



Data Systems Design offers a system that houses both an 8-inch Winchester drive and an 8-inch floppy. The controller board sits behind the drive units.

One opening allows the read/write head of the drive to come into contact with the oxide; a hole in the diskette center lets the drive spindle rotate the disk; an index hole provides timing information; a notch on one of the jacket's sides serves as a mechanical "write-protect," to prevent accidental erasure of the information on the disk. (see Fig. 1).

Information stored on any disk is organized much like the grooves of a record, with the data contained on anywhere from 35 to 77 concentric tracks. These tracks are further subdivided into sectors. A sector is a wedge-shaped portion of a track, with the point of the wedge aimed at the center of the disk. A floppy disk or diskette can be classified as either hard-sectored or soft-sectored, depending on how the drive system keeps track of where the sectors are. (see Fig. 2).

A hard-sectored disk has a hole in front of each sec-

tor to provide timing information to the drive, and there is also an index hole to provide position indication. Thus each sector is a fixed size, defined by the timing holes. A soft-sectored disk has a single index hole, and all sector locations are defined by the system's controller and software. This offers greater flexibility in storing data, but the flexibility comes at a price.

The soft-sectored disks do not hold as much data as the hard-sectored. This is because information concerning the size of a soft sector must be stored within the sector itself, eating into the disk's total storage capacity. However, most users prefer software flexibility to fixed formatting.

In addition to using both sides of floppy diskettes to increase storage, manufacturers also employ single- or dual-density recording techniques. Dual-density units use an improved code to fit twice as much data in the same disk area. Manufacturers also recently unveiled a quad-density recording technique that gives storage capacities four times greater than those of single-density drives.

Eight varieties of disk drives are available for the mini-floppy user, and another eight for the full-sized floppy user (quad-density units not included). As Table 1 shows, the capacities of the drives range from approximately 128 kilobytes for a single-sided mini-floppy to almost 2 megabytes for a dual-sided, dual-density full-sized floppy.

If we converted storage capacities to typed pages, we would get 25 to 35 single-spaced, typewritten pages for the low-end mini-floppy and about 400 pages for a dual-sided, dual-density 8-inch floppy.

The case for hard disks

Like the floppies, hard disks are covered with magnetic storage material. The similiarities end there.

A hard disk is a permanent part of a drive system. It cannot be replaced in the drive at will the way a floppy can. Instead, disks can be stacked like phonograph records on a spindle. A hard disk is a finely-honed piece of metal manufactured to exacting tolerances for smoothness and symmetry. It has no holes for timing; all information is extracted from data stored.

Several types of magnetic materials are used on hard disks. The most common coating is a magnetic oxide, similar to that used on floppies, but plated and thin-film materials, which promise to provide many times the recording density of oxides, are emerging from research laboratories.

The improved performances of the new substances are due to two factors: first, both materials yield smoother disks, and, second, data bits can be packed closer together. The latter is true because the flatter surfaces permit read/write heads to go closer to the disks, and the magnetic fields used for reading and writing data can be manipulated more exactly.

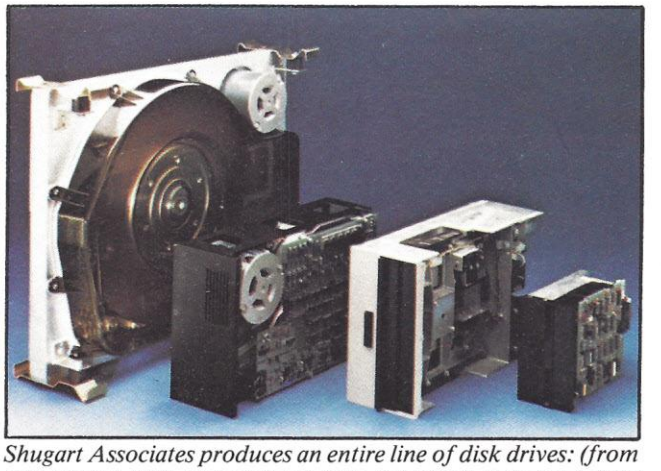
Unlike floppies, hard disks are housed in a totally protected environment to guard against contamination from moisture, dirt, dust, smoke particles, hair and a thousand other things. The protection usually consists of a plastic housing that contains a filter through which air is forced from the housing by the spinning motion of the disk, thus barring entry to potentially harmful contaminants.

Hard disks are much more sensitive to contaminants than their floppy kin because of the minute tolerances involved. The gap between a read/write head and a hard disk's surface is typically 1 to 2 microns (0.00004 to 0.00008-inch), or about one-fiftieth the diameter of a hair. Under these conditions, dust particles look like boulders and a single hair is a wall.

When compared with floppy disk drives, hard disk systems offer a major improvement in operation and data reliability in environments that harbor airborne contaminants.

Although the first 14-inch hard disk drives, with storage capacities ranging from 20 megabytes to over 600 megabytes, were designed for large computer sys-

Exploded view of the Irwin International 510 5¼-inch Micro-Winchester disk drive details the system's component layout. Detailed in the photograph are: 1, device control and interface; 2, head positioner motor; 3, spindle head motor; 4, disk read/write heads; 5, air filter; and 6, cartridge tape drive. One of the most outstanding features of the system is the integrated tape backup for the disk which can back up the hard disk's 10.2 megabyte storage capacity in less than four minutes. The small tape cartridge is removable for transportability and archive storage.



Shugart Associates produces an entire line of disk drives: (from left) the SA4000 14-inch hard disk; SA1000 8-inch hard disk; SA851 8-inch floppy; and the SA400 mini-floppy.

tems, manufacturers have scaled down the drive units to provide from 5 to 60 megabytes of on-line storage for small business and personal computer users.

The name Winchester, associated with the more popular hard disk systems, derives from the code word used by IBM for the first versions of its Model 3340 14-inch disk drives. Major development when other manufacturers picked up the technology, focused initially on the 8-inch Winchester that is now available from over a half dozen sources. Data capacities of the 8-inch drives range from approximately 4 to 60 megabytes, depending on the number of disks used in the drive. By 1982, data storage should be above 120 megabytes. Today's typical single-disk, 8-inch Winchester holds 6 to 12 megabytes of data.

The recently unveiled mini-Winchesters with 5¼-inch disks, offer an alternative to computer system designers who want to include a few megabytes of nonremovable storage as part of a small computer system. Expected to sell for approximately three times the price of a floppy disk, yet offering six to ten times the data transfer rate, and double to quadruple the storage of the mini-floppies, these mini-Winchesters appear to offer excellent system performance with little cost penalty.

Understanding specifications

If all you had to worry about was storage capacity when selecting a drive unit, you really wouldn't have much of a problem. There are, however, other specifications relating to storage speed that you should take into consideration. One is *access time*—the time it takes a drive to access data randomly.

Most companies specify an average access time for their systems. The specification is often derived by determining one-half of a unit's worst access time value. Access times typically run 400 to 600 milliseconds (ms) for 5¼-inch mini-floppies, 150 to 300 ms for 8-inch floppies and below 60 ms for most of the hard disk drives.

The average access time is really the sum of two other

Disk Glossary

Base Material — The polyester substrate to which magnetic media is bonded.

Certification — The process (during manufacturing) of detecting and removing defects that may cause data errors on a diskette.

Diskette — A flexible, circular recording medium, with a substrate made of polyester and coated with metallic oxide particles, that is designed to receive and store digitally coded information for later retrieval.

Diskette Assembly — The combination of a diskette, jacket and liner. Also called a diskette cartridge assembly.

Double Density — A digital recording method whereby data bits are used for system clocking instead of alternating a clock bit with a data bit as is done in single density recording. The absence of clock bits allows data bits to take their place, thus doubling the bit density of the diskette.

Envelope — The outer, protective covering that fits around a diskette assembly to prevent damage and contamination during use, storage or mailing.

Floppy — A term used to describe a diskette's flexibility when free of its protective jacket.

Format — The structuring of the magnetic recording area of a diskette, either physically or electrically, into uniformly organized segments where data may be recorded, stored and retrieved.

Hard Sector Format — A configuration in which the recording surface of a diskette is physically divided into sectors by an evenly spaced series of punched holes on either the inner or outer diameter of the diskette.

Head Aperture — A slotted area of a diskette jacket that allows the recording head of the disk drive physical access to the diskette media. All recording and data retrieval occurs in this location.

Hub Access Hole — The hole in the center of a diskette into which the drive hub of the transport fits.

IBM Compatible — A configuration wherein track and sector addresses are initialized on a diskette by the manufacturer and which allows interchangeability between IBM systems and systems compatible with them. Also referred to as "industry compatible."

Index Hole — A physical hole in a diskette which, when detected, notifies the drive that the beginning of a track is under the read/write head.

Initialization — An electrically-coded pattern recorded on a diskette to identify the beginning, end and address of each "soft" sector.

Jacket — A protective vinyl covering, lined with a soft, non-woven synthetic material that encloses the diskette. The diskette can rotate freely within the jacket and the jacket's design permits storage and handling without contacting the diskette inside.

Liner — A soft, non-woven synthetic material selected for its wiping and special anti-friction characteristics. The liner is precision-bonded to the interior of the jacket and provides minimum resistance to the rotation of a diskette.

Magnetic Media — A fine coating of ferric oxide that is bonded to a diskette's base material and which is capable of receiving and storing digital information.

Non-IBM Compatible — A diskette configuration for use on equipment that is not compatible with IBM systems. Sector locations are not established by initialized addresses at the time of manufacturing but by the users.

Sector Holes — The punched holes around the inner or outer diameter of a "hard" sectored diskette that identify the beginning, end and address of each sector.

Single Density — A digital recording method whereby each data bit is preceded by a clocking bit that is used to synchronize the internal clock of the system.

Soft Sector Format — A configuration in which the recording surface of a diskette is electrically divided into sectors by an initialized coded address pattern unique to each sector.

Write Protect Notch — An optional notch in a diskette's jacket which, when covered (or uncovered depending on the system being used), prevents inadvertent recording on the diskette.

specifications: *average latency time* and *track-to-track seek time.*

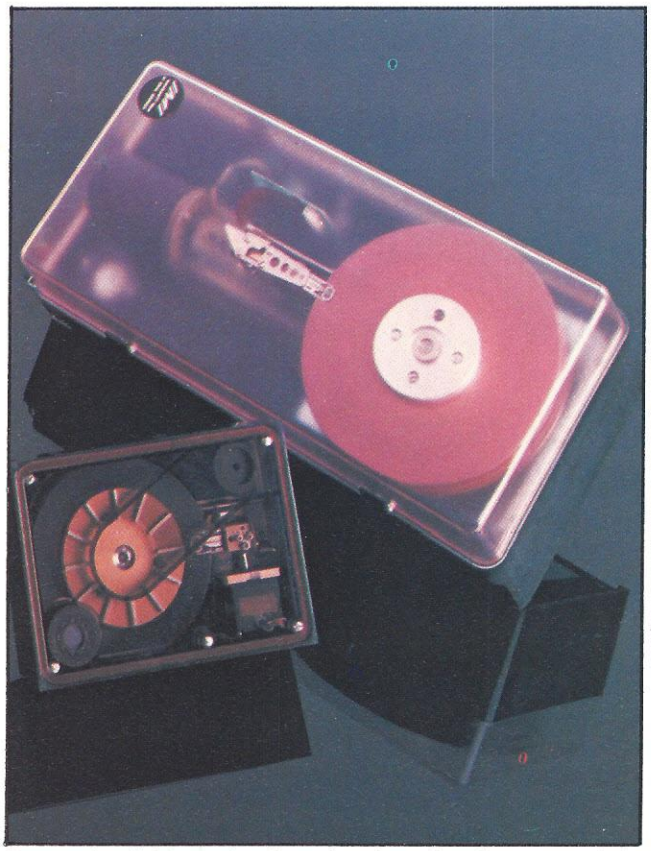
Latency time relates to the rotation time of a disk. To illustrate: Assume that a disk has just rotated past a point where desired data are located. Latency time is the time the disk needs to spin the desired data to a position under the read/write head (almost a full rotation). The 5¼-inch floppies generally take about 100 ms. In 8-inch floppies the time drops to about 83 ms, and with hard disks (both 5¼- and 8-inch units), the time drops even further, to 20 ms.

Track-to-track seek time is the time it takes for a read/write head to shift from one track to another. The specification is usually the average of the worst situation as the head goes from track 0 to the last track. The average is derived by dividing the worst time in half. Typical numbers for average seek times range from 3 to 25 ms for 5¼-inch floppies, 3 to 100 ms for 8-inch floppies and 20 to 70 ms for most hard disk drives.

Who cares about latency times? Actually, you should. When your computer system accesses a disk drive, the time it takes to reach the first character byte puts a limit on system performance.

Another limitation on system performance is the time it takes for a disk drive to transfer its data to the computer. The faster that data can be transferred, the sooner your computer can start execution; thus *transfer rate* is also an important specification. For most 5¼-inch units, transfer rates are either 15.6 or 31.2 kilobytes-per-second, depending on whether single- or double-density recording techniques are used. In 8-inch models, transfer rates are typically 31.2 or 62.5 kilobytes-per-second, but there are exceptions. Burroughs has several drives that transfer at 125 kilobytes-per-second, as does IBM, and Micropolis offers some

Industrial Micro Systems International's Model 16 Hard Disk Subsystem is a "fixed-removable" high-speed, bulk storage device providing from 32 to 96 megabytes of on-line storage.



International Memories Inc., has introduced a 5¼-inch, 7 megabyte Winchester disk drive that complements the firm's 8-inch disk line.

5¼-inch mini-floppies that transfer at 38 kilobytes-per-second.

In the hard disk field, transfer rates for 8- or 14-inch Winchesters are, for the most part, well over 400 kilobytes-per-second, with many units working at about 600 kilobytes. Even mini-Winchesters with 5¼-inch disks offer transfer rates between 600 and 800 kilobytes-per-second. If your computer applications involve the transfer of large blocks of data, hard disk drives can cut data transfer and access delays by almost a factor of four, turning that time into overall system performance improvement. A point not related to storage speed and that should also be considered before you buy a disk drive is the type of power supply the drive requires. This is particularly true if you intend to work with a bare drive instead of buying a unit that can be daisy-chained into an existing drive system. Some disks require only dc power and can obtain that power from the computer's power supply; other units need ac power for their motors and dc power for the rest of the control circuitry. Unless you plan to do a lot of do-it-yourself construction, the most time-efficient route will be to purchase complete subsystems, such as those offered by either computer system manufacturers or by support companies.

Data duplication

No matter what kind of disk drive you ultimately purchase, you will be faced with a situation common to all: What do you do if a disk goes bad or if the head damages a diskette's magnetic coating to the point that data on the disk cannot be recovered? When a disk crashes and you have failed to provide for a *backup,* all missing data will have to be re-entered (if you still have

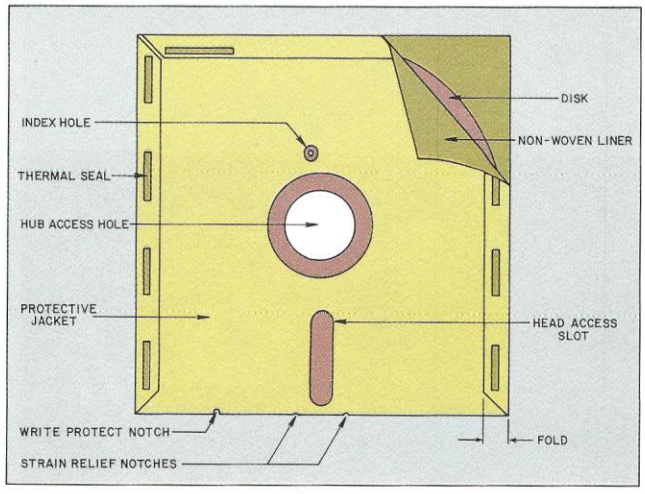


Figure 1—A floppy disk is encased in a nonremovable jacket that protects the Mylar surface from contaminants. The series of notches, holes and openings in the jacket allow a microcomputer to store and/or recall coded information.

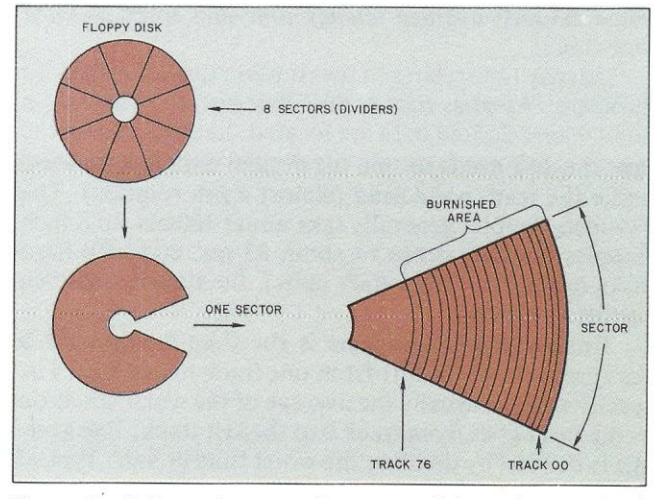


Figure 2—Information stored on any diskette is organized much like the grooves of a record, with the data contained on anywhere from 35 to 77 concentric tracks. Tracks are further divided into wedge-shaped portions called sectors.

the information you need). How often should you back up your files? Experts are still debating. Many companies back up data once a day, others once a week, and some every hour. Backup frequency depends on how critical your information is and how often it changes.

To avoid the manual hours necessary to replace a complete disk of data, many disk units have a backup system. A hard disk may have a floppy disk or a cartridge or reel tape drive as backup, while a floppy will probably use a cassette tape or another floppy.

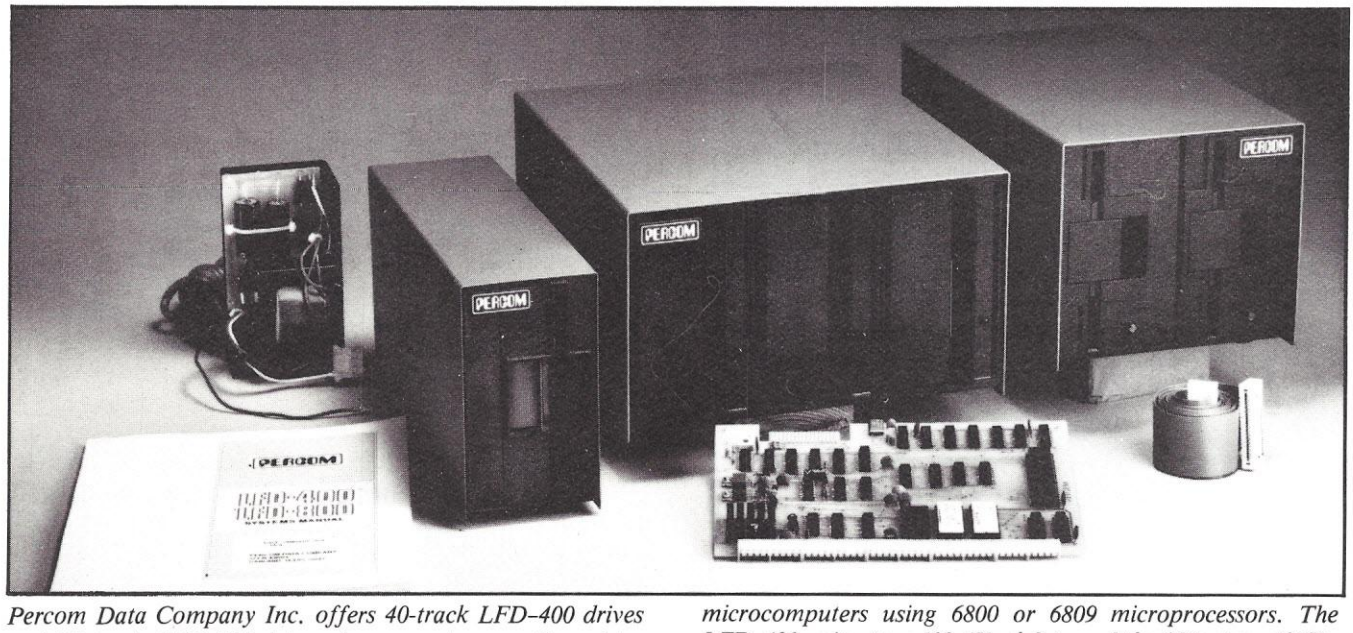
To solve the problem of matching backup components to a disk system, many drive vendors offer combination subsystems that have both a disk and a backup system drive in the same cabinet. A combination package makes duplicating data easy, because all you have to do is insert the blank tape or floppy and have the system perform a "dump" of the data onto it.

Floppy-disk systems offer an advantage in making backups, even in single-drive systems. All you have to do is transfer your data into the computer system's memory a few blocks at a time, remove the data diskette, put another diskette into the drive, and dump the data from the computer to the new diskette. You repeat this process until all data are copied.

In multiple-drive systems, all you have to do is a disk-to-disk copy from one drive to another. With most of the Winchester systems, however, this kind of transference process isn't possible, because disks aren't removable. You must use some other technique, such as backing up with floppy or tape.

The problem of backup for Winchesters may soon change, however, in light of recent developments by Memorex and the Control Data Corporation. Both companies have developed Winchester drives that use removable disk packs. The Memorex system consists of a patented cartridge case that contains both a disk and special interlocks that keep the case sealed until it is inserted into a drive. Control Data's unit has both fixed and removable disks.

Tape backup systems tend to break into two market



Percom Data Company Inc. offers 40-track LFD-400 drives and 77-track LFD-800 drives for one-, two- or three-drive microcomputers using 6800 or 6809 microprocessors. The LFD-400 units store 102.4K of data and the 800s store 197K.

segments: one for backing up 10 to 20 megabytes and the other for the 20-to-200 megabyte range. In the lower segment, the 3M 1/4-inch tape catridge and drive offer enough storage capacity at a moderate price. For larger storage needs, a more expensive 1/2-inch tape drive provides sufficient room.

As disk drives continue to increase in capacity, there will be a need for ever-increasing backup capability. A rule of thumb used by many industry experts is that disk-to-tape dumping take no more than 15 minutes. With today's tape drives recording at 1600 bits-per-inch and the tape moving at up to 100 inches-per-second, 40 megabytes can be stored in just four minutes; thus 150 megabytes can be dumped in about 15 minutes. As storage requirements grow, new coding techniques will permit even higher density recording without a resultant decrease in data reliability.

Transporting media

Many users face the problem of transporting data from one location to another. To date, the floppy disk has become the medium of exchange in a majority of systems, but the tape cassette still remains a popular storage medium for the exchange or sale of programs for personal computing applications.

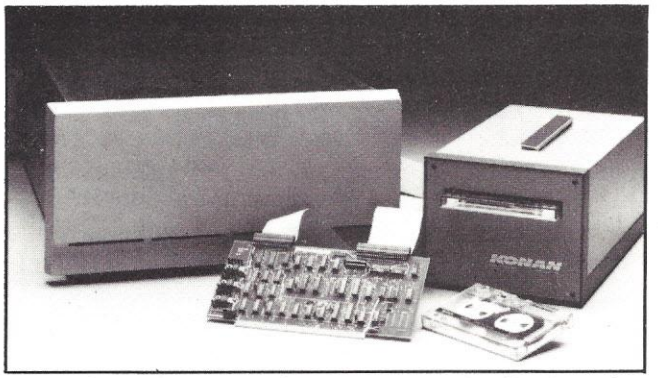
When you examine a drive system's *transportability,* make sure that the disks in a multi-drive system are compatible—hard-sectored or soft-sectored—and that the encoding technique for them is the same. With some of the newer quad-density floppy disk drives, there is little transportability because there are few such drives in use at present. Only a drive that handles quad-density encoding can read from or write to a disk recorded with quad-density data. For most other floppy disk recording techniques, many of the drives available can handle single or double-density encoding and decoding, and the transfer of disks between systems is less of a problem.

Surveying the field

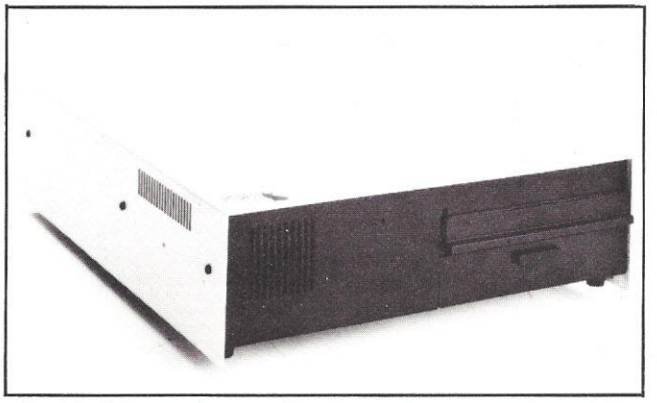
Depending on the type of equipment that you plan to buy—bare drive, drive with power supply or complete package with controller (an electronic interface between the disk drive and the computer)—there are different groups of companies you'll have to deal with to get your system up and running.

For some of the popular microcomputer systems, such as the Radio Shack TRS-80, the Apple II from Apple Computer, the Heath H89 and the many S-100 and SS-50 computers, you can easily purchase drives with or without the necessary controllers, power supplies and interface cards.

Many of the S-100 interfaces available handle floppy disk subsystems, some designed for a 5¼- or 8-inch drive and some that can handle either size or a mixture of both. In the last year or so, several companies, such as Morrow Design and XComp, have introduced controllers for both 8- and 14-inch hard disk drives. Similarly a wide selection of drives is available for microcomputer systems like the TRS-80 and Apple. Cameo Electronics, for example, offers a hard cartridge disk system, the DC-500, that adds megabytes of memory to the TRS-80, Apple, H89 or any S-100 system. Jade Computer Products and Matchless Systems offer 8-inch dual disk systems for the Apple and other

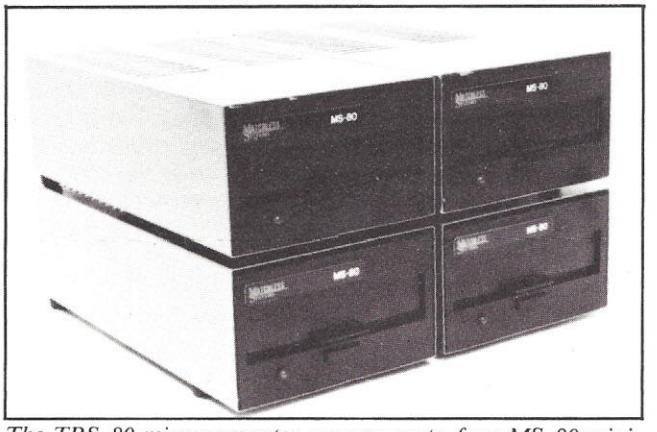


Konan's HARDTAPE subsystem provides backup for Winchester-type hard disk systems, and it yields complete hard disk backup with verification in 20 to 25 minutes.



The Model 1850 from Lobo Drives International combines both a fixed disk and a floppy disk into one unit to give Apple and TRS-80 computers large storage capabilities.

The Apple III computer features a 5¼-inch floppy disk drive built into the unit's cabinet. Three more disk drives can be added externally for increased storage.



The TRS-80 microcomputer can use up to four MS-80 mini-disk drives from Matchless Systems. The 40-track units have a track-to-track access time of five milliseconds.

Table 1

5¼-inch Floppies

Format	Sector Type	Unformatted Storage Capacity	Transfer Rate Kilobytes Per Sec.
Single-density/ single-sided	Soft	128 kbytes	15.6
Single-density/ dual-sided	Soft	256 kbytes	15.6
Double-density/ single-sided	Soft	256 kbytes	31.2
Double-density/ dual-sided	Soft	512 kbytes	31.2
Single-density/ single-sided	Hard	235 kbytes	15.6
Single-density/ dual-sided	Hard	470 kbytes	15.6
Double density/ single-sided	Hard	470 kbytes	31.2
Double-density/ dual-sided	Hard	950 kbytes	31.2

8-inch Floppies

Single-density/ single-sided	Soft	400 kbytes	31.2
Single-density/ dual-sided	Soft	800 kbytes	31.2
Double-density/ single-sided	Soft	800 kbytes	62.4
Double-density/ dual-sided	Soft	1.6 Mbytes	62.4
Single-density/ single-sided	Hard	256 kbytes	31.2
Single-density/ dual-sided	Hard	510 kbytes	31.2
Double-density/ single-sided	Hard	510 kbytes	62.4
Double-density/ dual-sided	Hard	1 Mbyte	62.4

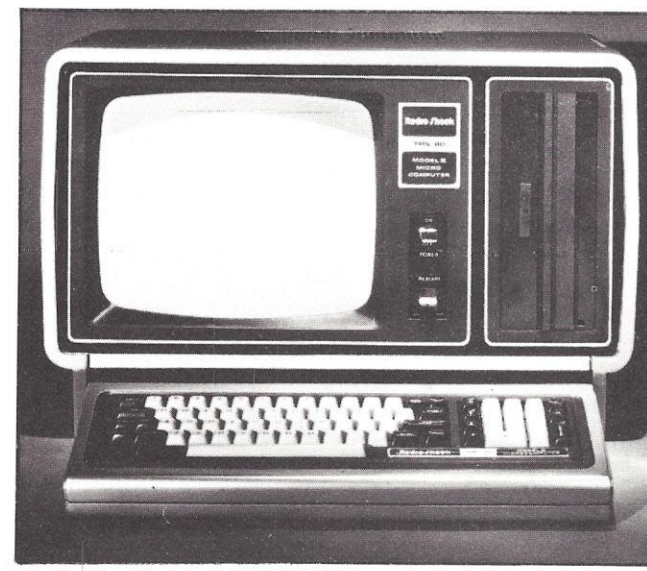
Eight varieties of disk drives are available for the mini-floppy user, and another eight for the full-sized floppy user (quad density not included). As you can see, the capacities of the drives ranges from approximately 128 kilobytes for a single-sided mini-floppy to almost two megabytes for a dual-sided, double-density, full-sized floppy. If you convert storage capacities to typed pages, you would get 25 to 35 single-spaced, typewritten pages for the low-end mini-floppy and about 400 pages for a dual-sided, double-density, 8-inch floppy.

computers. Lobo Drives and Corvus provide 8-inch hard disks for the Apple, while Lobo also has interfaces for the TRS-80 and S-100 bus systems. Percom Data sells multiple floppy drive systems for the SS-50 and Exorciser (Motorola's MC6800 development system) buses.

Some problems arise when trying to purchase plug-compatible units. Drives for the Apple Computer, for example, are available from only a limited number of sources, because Apple's engineers developed their own special drive control electronics to go into the unit. The company purchases the drive assembly without the standard circuitry of the drive's manufacturer, making it difficult to duplicate the exact system.

Using a different approach, other companies such as Lobo, Vista, MicroSci, A. M. Electronics, and the J. R. Inventory Co. have developed their own controllers and interfaces for the Apple and now offer compatible disk subsystems. Interface Inc., Computhink, MicroMart, Inc., Apparat, Inc., and others provide systems that interface to the TRS-80.

Most common of all are systems that interface to the



Radio Shack's Model II TRS-80 has a built-in 8-inch disk drive capable of storing 416,000 characters. Three additional 8-inch drives can be added to the system externally.

Zenith Data Systems' built-in 5¼-inch floppy allows 100K bytes of on-line data storage, and an external, dual-sided, double-density, dual drive unit holds 2 megabytes.

S-100 bus. Interface boards are available from over a dozen companies, including NorthStar, Morrow, Cromemco, Intersystems, Tarbell, California Computer Systems, Wameco, SD Systems, and Western Digital.

Northstar, Morrow, Micromation, Micropolis, Industrial Microsystems, Electro Labs, Lobo, Corvus and a number of other firms sell complete disk drive systems in addition to the ones that computer systems manufacturers offer as options.

If you already have a disk system with the interface and power supplies to support additional drives, you have the relatively simple (and much less expensive) job of purchasing a bare drive and mounting it in your system cabinet. Unless the unit's manufacturer has modified the electronics or mechanical design of your initial system, you'll probably be able to select an additional drive from among those offered by over a dozen manufacturers.

In some instances, floppy disk drive manufacturers, have adopted a relatively "standard" interface, and you will find many drives basically plug-compatible with one another. Many drives are patterned after those introduced by Shugart Associates, a leader in floppy-disk drive technology. As for hard-disk drives, many companies sell them with an SMD (Storage Module Drive) interface, a carryover from the larger, 14-inch drives.

An alternative to a card that mates to the specific bus of a computer system is an interface that connects a disk drive to the computer through a port. Some companies offer a serial, floppy interface that permits a drive to operate through an RS-232 port; others have developed parallel interfaces that permit a drive to connect through a parallel port.

What do they cost?

Single-unit retail prices for disk drives start at about $350 for the drive mechanism with the basic contol electronics. The full-sized 8-inch floppy drives start at about $550 for a similar hardware setup, while 8-inch Winchester units are in the $2500 to $3500 range and 5¼-inch Winchesters in the $1500 to $2000 range.

Most expensive of all, the 14-inch Winchester drives start at about $5000 and rise to well over $75,000 for the multihundred megabyte units. And, of course, if you don't already have a controller card for the drive, that can add another $200 to $5000, depending on the drive selected. □

Disk Vendors Guide

Adaptive Data & Energy Systems, 2627 Pomona Blvd., Pomona, CA 91768, (714) 594-5858 **Circle 150**

American Computer and Telecommunications Corp., 11301 Sunset Hills Road, Suite A-4, Reston, VA 22090, (703) 471-6288 **Circle 151**

A. M. Electronics, 3366 Washtenaw Ave., Ann Arbor, MI 48104, (313) 973-2312 **Circle 152**

Apparat Inc., 4401 S. Tamarak Pkwy., Denver, CO 80237, (303) 741-1778 **Circle 153**

Apple Computer Inc., 10260 Bandley Dr., Cupertino, CA 95014, (408) 996-1010 **Circle 154**

Burroughs Corp., Burroughs Place, Detroit, MI 48232, (313) 972-8031 **Circle 155**

California Computer Systems, 250 Caribbean Dr., Sunnyvale, CA 94086, (408) 734-5811 **Circle 156**

Cameo Data Systems Inc., 1626 Clementine St., Anaheim, CA 92802, (714) 535-1682 **Circle 157**

Commodore Business Machines, 950 Rittenhouse Rd., Norristown, PA 19403, (215) 666-7950 **Circle 158**

Computhink, 965 West Maude Ave., Sunnyvale, CA 94086, (408) 245-4033 **Circle 159**

Control Data Corp., Peripheral Products Div., 4000 N.W. 39th St., Oklahoma City, OK 73112, (405) 946-5421 **Circle 160**

Corvus Systems, 2029 O'Toole Ave., San Jose, CA 95131, (408) 946-7700 **Circle 161**

Cromemco Inc., 280 Bernardo Ave., Mountain View, CA 94043, (415) 964-7400 **Circle 162**

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IMS international, 2800 Lockheed Way, Carson City, NV 89701, (702) 883-7611 **Circle 168**

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Jade Computer Products, 4901 W. Rosecrans, Hawthorne, CA 90250, (213) 679-3313 **Circle 172**

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Konan, 1448 N. 27th Avenue, Phoenix, AZ 85009 (602) 269-2649 **Circle 174**

Lobo Drives International, 935 Camino Del Sur, Goeleta, CA 93017, (805) 685-4546 **Circle 175**

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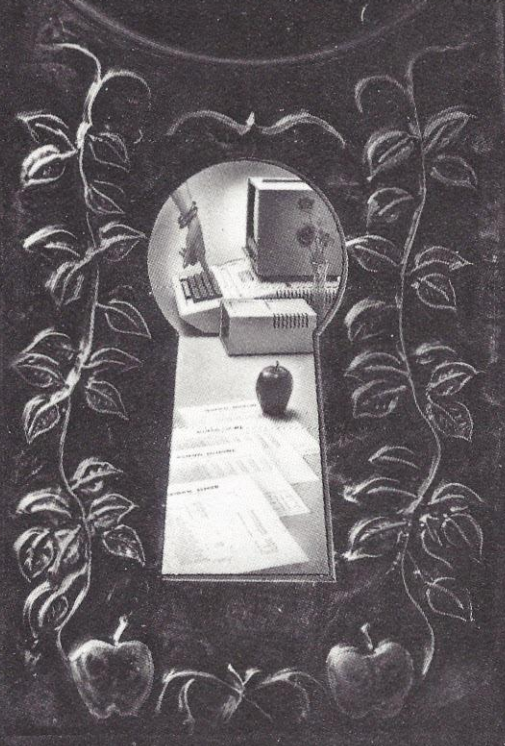

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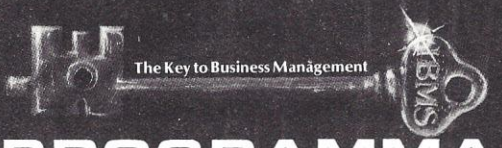

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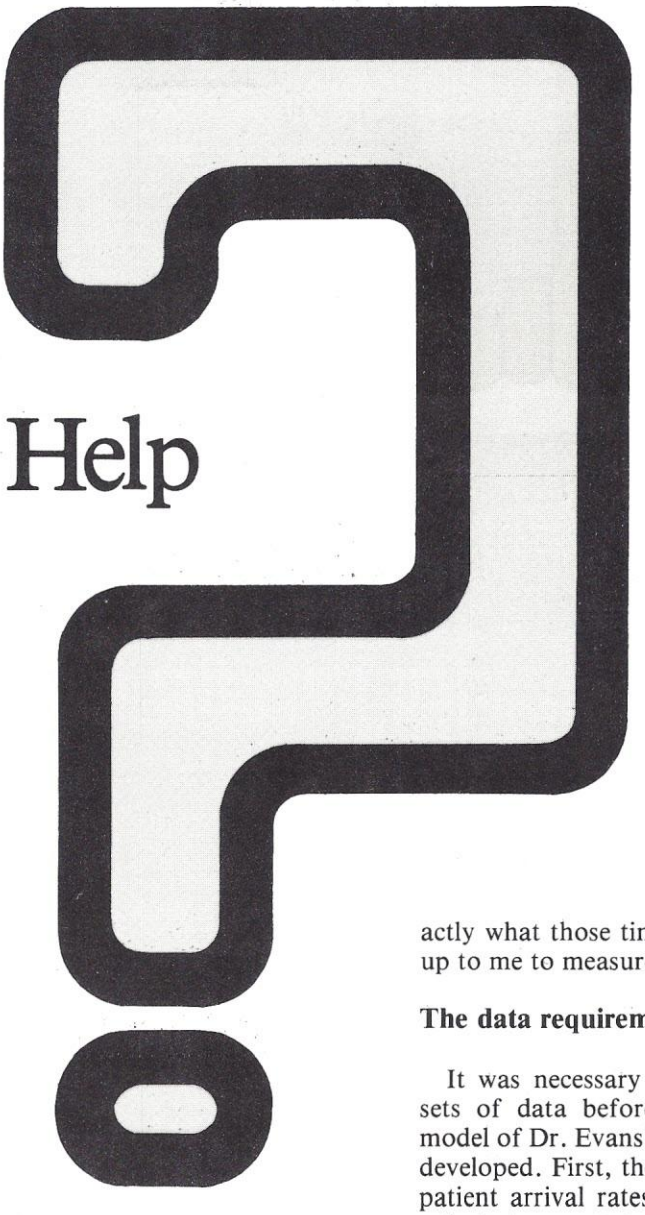
Simulation: How Can It Help



BY CHARLES J. WILSON

The previous article in this series examined the fundamentals of probability theory and gave computer subroutines for seven probability distributions. In the current article, the author puts theory to work to solve an actual problem in the world of business. The steps taken follow the simulation study outline suggested in the first article in this series.

Robert Evans, M.D., a specialist in family practice, had been operating his one-doctor clinic on a nonappointment basis for many years. However, as his practice grew, so did increases in patient waiting time and, oddly, his own idle time also rose. This caused him concern, and he asked me to study his practice and recommend whether he should continue seeing patients without appointments or should convert to an appointment basis. Any recommendation for changing to appointments had to include the optimum appointment interval.

This is an excellent example of a queueing, or waiting-line, problem. Because the problem fit the classic mold, I used queueing theory as the basis of the simulation design, and it led to a significant improvement in the efficiency of the doctor's clinic.

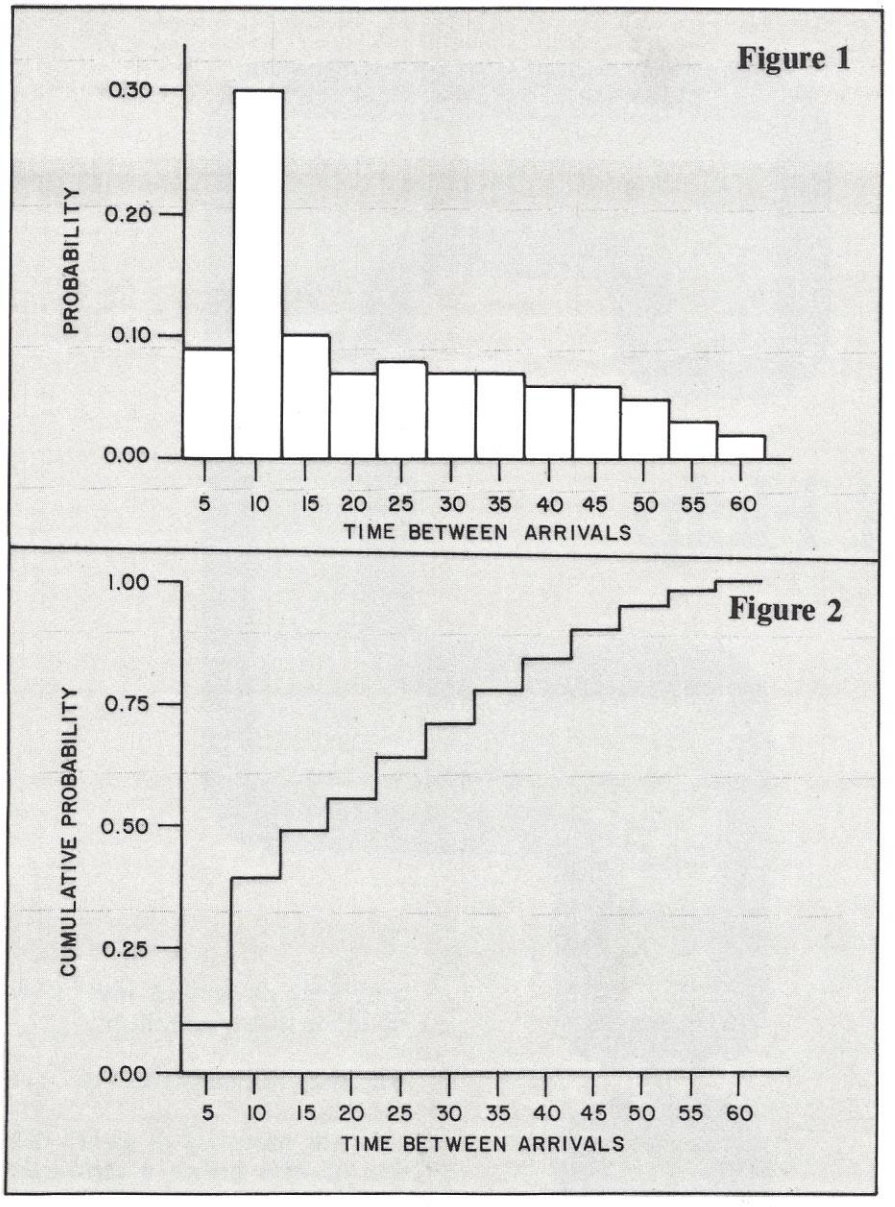
While this simulation was developed to solve a particular problem, it is easily adaptable to fit any queueing, or line-forming, situation. So if you are faced with a decision as to whether a bank should install a drive-in window, or how many check-out counters a supermarket should have, or any circumstance where customers line up for service, this simulation is for you.

In our first meeting, I asked Dr. Evans to spell out the problem and to define what degree of improvement he would find acceptable. He could not give me any quantitative data, but he expressed perplexity that even though he was seeing more patients each day than at any time in the past, he was frequently idle for long periods. In addition, the patients were having to wait longer and longer before receiving treatment. Idle time and waiting time had to be reduced substantially below the times of the existing system, although Dr. Evans did not know exactly what those times were. It was up to me to measure them.

The data requirements

It was necessary to gather three sets of data before a satisfactory model of Dr. Evans's clinic could be developed. First, the distribution of patient arrival rates (or time intervals between arrivals) had to be found. This information was needed if I was to examine the clinic system as it existed. The time intervals between arrivals were measured for 300 patients over a three-week period, and the frequency distribution of these intervals was plotted (Figure 1). The distribution had a significant peak when the time between arrivals was 10 minutes. The cumulative distribution for time between arrivals was then plotted (Figure 2). A quick computation gave a mean time between arrivals of 23.35 minutes.

The second set of necessary data was the distribution of service times—that is, the time Dr. Evans spent treating a patient. This distribution was essential for modeling the existing system and for suggesting modified systems, since it



The frequency distribution for time intervals between patient arrivals is first plotted (Figure 1), and from this, a cumulative distribution is then graphed (Figure 2).

was expected that the distribution of treatment times would not change with any change in how the patients arrived. The distribution of service times, based on the 300-patient sample, were plotted (Figure 3), and so was the cumulative distribution (Figure 4). The average service time was 20.3 minutes.

It was good that this time was shorter than the average time between arrivals. If it were the other way around, the queue would grow larger and larger, and the waiting room would have to be expanded.

The final information required for the model concerned the priority of the patients. Dr. Evans normally saw patients in the order in which they arrived—or, in queueing theory jargon, the queue discipline was first-in/first-out (FIFO). However, in emergency cases, a patient was placed at the head of the queue and Dr. Evans saw this patient immediately after completing treatment of the patient he was then dealing with.

Based on the sample, three percent of the patients were high-priority patients. Two-thirds of these (2 percent of all patients) were designated as "Priority 2," indicating that the emergency required 30 minutes of Dr. Evans' time. The remaining third were designated "Priority 3" and took 60 minutes of treatment time. Regular patients were classified as "Priority 1."

Developing the model

I decided at the outset to make the model as general as possible so it could be used with a minimum of reprogramming for other queueing problems. A flow diagram of the simulation is given in Figure 5. My discussion of the model follows the flow of the listing on page 87.

Initially, most variables are defined as integers to minimize memory requirements, the random number generator is reseeded and several arrays are dimensioned. The larger dimension for AD determines the maximum iterations (days in this case) that can be done. I have set it at 200, because a higher figure would have exceeded the memory limits of my 16K TRS-80. Two hundred iterations should be sufficient to allow you to be confident of the simulation's results.

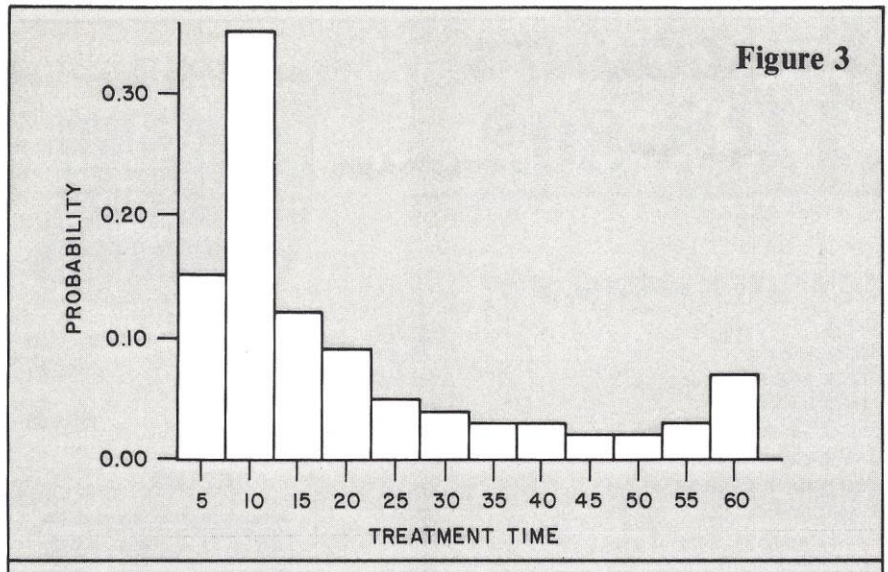
However, if you have more memory, you might want to increase the size of this array so you can increase the iterations.

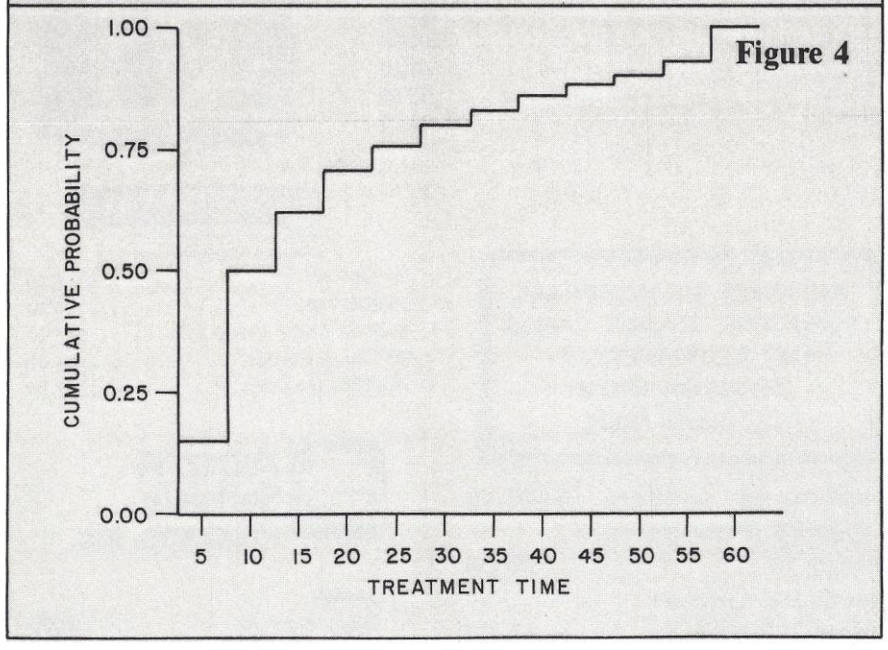
The next input is the appointment interval. A value of 0 is entered if the arrivals are to be random. With random arrivals, the cumulative probability distribution must also be put in. The probabilities are entered as percentages—that is, the certainty of the event is 100 rather than 1.0. Again, this requirement was put in the program to allow the model to operate primarily in the integer mode. Figure 7 shows the display after the arrival time distribution has been entered.

Remember the doctor's requirement that, even under an appointment system, priority patients were to jump to the head of the line. If patients did not differ with respect to priority, there would be no need to ask about the appointment intervals. If you wanted to establish an appointment interval, you would merely enter a single-point cumulative distribution, assigning the desired interval a 100 percent chance of occurring.

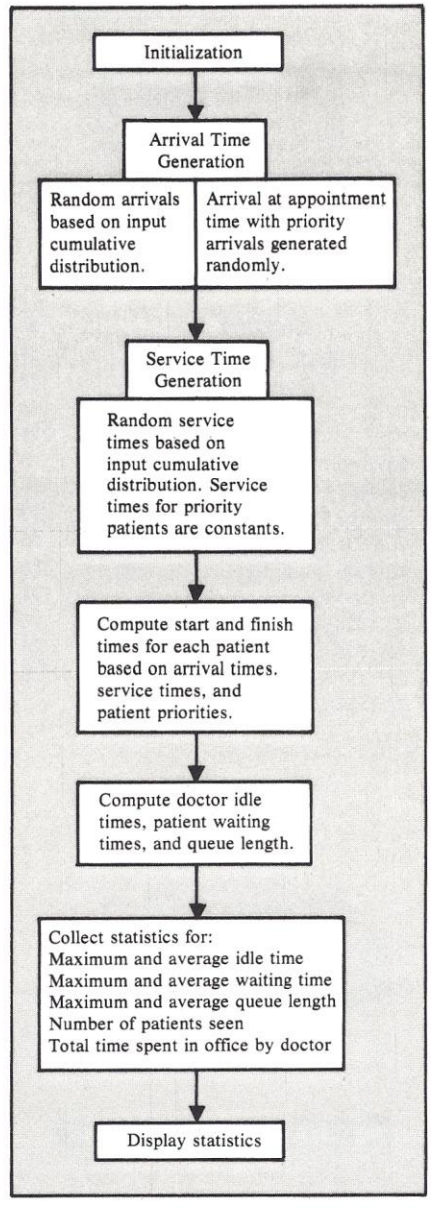
Once the pattern of arrivals is entered, the service time distribution must follow as an input. A constant service time can be obtained by use of a single-point cumulative distribution.

The next entries are the length of the day (in this case, the time during which patients are admitted to the clinic), the number of iterations (days), and whether the print-out is to be detailed or a summary. Various array dimensioning is then done with the "50" shown in the listing of Figure 6 indicating that up to 50 patients a day can be handled suc-





The distribution of service times, based on the 300-patient sample, is plotted (Figure 3), and so is the cumulative distribution of these times (Figure 4).



This situation flow diagram follows the listing on pages 87 and 88.

cessfully by the model.

Now the simulation begins. For each iteration, the program first computes the time of arrival, A(I), of each patient. Patients are accepted until the maximum time is exceeded. For random arrivals, the arrival times are found by use of the cumulative distribution. Patient priorities, C(I), are randomly assigned. For appointment situations, a subroutine is used (GOSUB 2000) to compute the arrival times. Emergency patients continue to arrive randomly.

After the arrival times are computed, calculations must be made for the service time, S(I). The cumulative distribution is used unless the patient is Priority 2 or 3.

We now compute for each patient the time that treatment starts TS(I), and treatment finishes, TF(I). This, in turn, permits the computation of the time a patient spends waiting, WT(I), or the idle time of the doctor while waiting for the arrival of a patient, ID(I). The queue length, L(I), at the time of each patient's arrival is also found.

Maximum values for idleness, waiting and line length are saved for each day. The computations are rather straightforward, except in those instances where a Priority 2 or 3 patient arrives. Here the various arrays have to be juggled to move the high-priority patient to the head of the line. These gyrations make up the bulk of the computational part of the model

At the end of each simulated day, a detailed printout showing the various times associated with each patient is made, if that option has been selected (Figure 8). This printout is done in increments of 10 patients to permit review.

Whether or not the detailed printout option is selected, there is a summary display of each day's results (Figure 9). However, if the detailed printout option has been selected, the program will not begin the next iteration until directed to do so by the programmer.

After all iterations are completed, statistical parameters (mean and standard deviation) for each of the variables of interest are computed and displayed (Figure 10).

The programmer also has the option of displaying histograms of the variables (Figure 11).

Each aspect of the simulation was

(continued on page 63)

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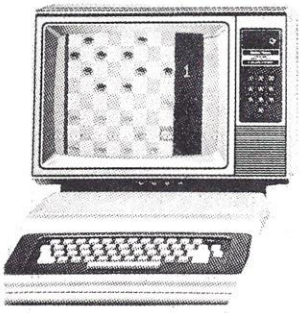

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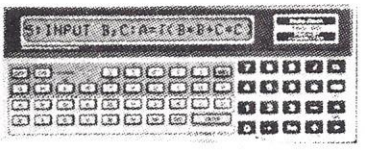

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CIRCLE 12

Estimate Trip Costs in BASIC or Pascal

BY SAM GAYLORD

Pascal, once the province of professors and computer scientists, is finally emerging from its role as a campus favorite to become the paragon of high-level programming languages—lingua franca of the ongoing mini-micro revolution and its new generation of small business and personal computerists. Pascal is the fastest-growing, high-level computer language. Pascal has a way of winning instant converts on a "try-it-once-and-get-hooked" basis.

Personal computing, if it is to grow and attract persons whose interests center on the uses and applications of microcomputers rather than on the nuts and bolts of the machines, will never reach maturity as long as its growth remains stunted by outdated, non-state-of-the-art languages such as BASIC and FORTRAN. Pascal's syntax encourages you to think in terms of data and what you want to do with the data thereby freeing mind and creativity from hardware concerns. In this way, Pascal helps you become a better programmer, faster.

A short article can't be a Pascal

BASIC Program Listing

```
10 GOTO 680
20 PRINT "THIS PROGRAM WILL HELP YOU FIGURE"
30 PRINT "THE COSTS OF AN AUTOMOBILE TRIP,"
40 PRINT "GIVEN A RANGE OF ESTIMATED MPS'S"
50 PRINT "AND A RANGE OF PUMP PRICES - EACH"
60 PRINT "IN STEPS THAT YOU CHOOSE."
70 PRINT : PRINT
80 PRINT "WHEN PROMPTED BY THE PROGRAM"
90 PRINT "ENTER THE DATA REQUESTED. AND"
100 PRINT "BE CAREFUL TO ENTER GAS PRICES"
110 PRINT "AS CENTS (105, NOT $1.05)."
120 PRINT : PRINT
130 PRINT "HAVE A GOOD COMPUTER RUN --"
140 PRINT "HAVE A GOOD TRIP --"
150 VTAB (18)
160 PRINT "AND -- DRIVE CAREFULLY!"
170 PRINT : PRINT
180 INPUT "TO GO ON, HIT 'G' AND <RETURN> ";G$
190 IF G$ = "G" THEN HOME
200 PRINT : PRINT
210 PRINT "ENTER MPG BOUNDS:"
220 INPUT "     1) LOWER --> ";ML
230 INPUT "     2) UPPER --> ";MU
240 INPUT "     3) STEP  --> ";MS
250 PRINT : PRINT
260 PRINT "ENTER PUMP PRICE BOUNDS (CENTS)"
270 INPUT "     1) LOWER --> ";PL
280 INPUT "     2) UPPER --> ";PU
290 INPUT "     3) STEP  --> ";PS
300 PRINT : PRINT
310 INPUT "HOW LONG A TRIP? ENTER MILES ";TD
320 MTC = 0: HOME : PRINT
330 INPUT "WANT HARD COPY? Y/N ";R$
340 IF R$ = "Y" THEN GOSUB 800
350 PRINT : PRINT
360 PRINT "HERE ARE COST ESTIMATES"
370 PRINT "FOR A TRIP OF ";TD;" MILES"
380 PRINT "GIVEN THE FOLLOWING DATA:"
390 PRINT : PRINT
400 PRINT "     1) FUEL PRICES (CENTS/GAL.)"
410 PRINT "        FROM ";PL;" TO ";PU
420 PRINT "        IN STEPS OF ";PS;" CENTS
    /GAL."
430 PRINT : PRINT
440 PRINT "     2) ESTIMATED MPG RATES"
450 PRINT "        FROM ";ML;" TO ";MU
460 PRINT "        IN STEPS OF ";MS;" MI.
    /GAL."
470 PRINT : PRINT
480 PRINT TAB(1)"MPG" TAB(9)"PRICE" TAB(18)
    "COST/MI" TAB(30)"TRIP COST"
490 PL = PL/100: PU = PU/100: PS = PS/100
500 PL = INT(PL * 100 + .5) / 100:
    PU = INT(PU * 100 + .5) / 100:
    PS = INT(PS * 100 + .5) / 100
510 PRINT "-----------------------------
    ----------------------"
520 FOR M = ML TO MU STEP MS
530 FOR P = PL TO PU STEP PS
540 C = INT(P / M * 1000 + .5) / 1000
550 TC= TD * C: TC=INT(TC * 100 + .5) / 100
560 GOSUB 760
570 PRINT TAB(2)M TAB(9)"$"P TAB(19)C
    TAB(31)"$"TC
580 NEXT P
590 NEXT M
600 PRINT
610 PRINT "-----------------------------
    ----------------------"
620 PRINT : PRINT
630 PRINT "WITH GAS AT $";WP;" PER GALLON"
640 PRINT "AND YOUR CAR GETTING ";WM;" MPG,"
650 PRINT "THE HIGHEST COST FOR THE ";TD;
    " MILES"
660 PRINT "IS $";MTC;" AS AN ESTIMATE."
670 END
680 HOME: CALL - 936
690 T$ = "TRAVEL COST ESTIMATOR"
700 VTAB(10): GOSUB 750
710 PRINT :T$ = "BY": GOSUB 750
720 PRINT :T$ = "SAM GAYLORD": GOSUB 750
730 FOR I = 1 TO 2800 : NEXT I
740 HOME : VTAB(5): GOTO 20
750 PRINTTAB((40 - LEN(T$)) / 2)T$:RETURN
760 IF TC > MTC THEN 780
770 RETURN
780 MTC = TC:WP = P: WM = M
790 RETURN
800 PR# 1
810 RETURN
```

Pascal Program Listing

```
PROGRAM GASOLINE;
VAR   LOPRICE,
      HIPRICE,
      PRICESTEP,
      PRICE,
      WORSTPRICE,
      LOMPG,
      HIMPG,
      MPGSTEP,
      WORSTMPG,
      MPG,
      DISTANCE : INTEGER;
      COSTPERMILE,
      WORSTCASE,
      TRIPCOST  : REAL;
      P         : TEXT;
      REPLY     : STRING;

PROCEDURE INITIALIZE;
BEGIN
  WRITELN;
  WRITE('HARD COPY? ');READ(REPLY);
  IF REPLY='YES' THEN
    REWRITE(P,'PRINTER:')
  ELSE REWRITE(P,'CONSOLE:');
  WRITELN('MPG BOUNDS(LOWER,UPPER)AND STEP ');
  WRITE('IN MI./GAL.--> ');READ(LOMPG,HIMPG,MPGSTEP);
  WRITELN('PRICE BOUNDS(LOWER,UPPER)AND STEP ');
  WRITE('IN CENTS/GAL.-->');READ(LOPRICE, HIPRICE,PRICE
STEP);
  WRITELN('HOW LONG A TRIP ARE YOU PLANNING? ');
  WRITE('--> ');READ(DISTANCE)
END; (*INITIALIZE*)

PROCEDURE PREFACE;
BEGIN
  PAGE(OUTPUT);WRITELN(P);
  WRITELN(P,'ESTIMATED COSTS OF A',DISTANCE,' MILE TRIP
','');
  WRITELN(P,'GIVEN THE FOLLOWING DATA: ');
  WRITELN(P);
  WRITELN(P,'  1) PUMP PRICES FROM $',LOPRICE/100:2:2,
  TO $',HIPRICE/100:2:2)
  WRITELN(P,'     IN STEPS OF ',PRICESTEP,' CENTS/GAL.');
  WRITELN(P,'  2) MPG RATES FROM ',LOMPG,' TO ',HIMPG);
  WRITELN(P,'      IN STEPS OF ',MPGSTEP,' MI./GAL.');
  WRITELN(P);WRITELN(P)
END;

PROCEDURE PRINTHEADING;
BEGIN
  WRITELN(P,' MPG     PRICE     COST/MILE  TRIP COST');
  WRITELN(P,'----------------------------------------')
END;

PROCEDURE COMPUTECOSTS;
BEGIN
  PRICE:=LOPRICE;WORSTPRICE:=0;
  MPG:=LOMPG;WORSTMPG:=0;
  WORSTCASE:=0;
  WHILE PRICE<=HIPRICE DO
  BEGIN
    REPEAT
      COSTPERMILE:=PRICE/MPG;
      TRIPCOST:=COSTPERMILE*DISTANCE;
      WRITE(P,MPG:4,PRICE/100:8:2);
      WRITELN(P,COSTPERMILE/100:12:3,(TRIPCOST)/100:14:
    2);
      IF TRIPCOST>WORSTCASE THEN
      BEGIN
        WORSTCASE:=TRIPCOST;
        WORSTMPG:=MPG;
        WORSTPRICE:=PRICE
      END;
      MPG:=MPG+MPGSTEP
    UNTIL MPG>HIMPG;
    PRICE:=PRICE+PRICESTEP;
    MPG:=LOMPG
  END
END;

PROCEDURE BADNEWS;
BEGIN
  WRITELN(P,'THE WORST CASE IS A COMBINATION OF');
  WRITE(P,WORSTMPG,' MPG AND PRICE OF ');
  WRITELN(P,' $',WORSTPRICE/100:1:2,' PER GALLON');
  WRITELN(P,' RESULTING IN A TRIP COST OF $', WORSTCASE
/100:3:2);
  WRITELN(P);WRITELN
END;

PROCEDURE BOTTOMLINE;
BEGIN
  WRITELN(P,'----------------------------------------');
  WRITELN(P);WRITELN
END;

BEGIN
  INITIALIZE;
  PREFACE;
  PRINTHEADING;
  COMPUTECOSTS;
  BOTTOMLINE;
  BADNEWS;
  WRITELN
END.
```

primer but you can draw your own conclusions as to Pascal's clarity by comparing the accompanying versions of the Trip Cost Estimator program for an Apple computer—one program is written in BASIC; the other in Pascal (UCSD).

Until a few months ago, I never programmed in *any* language. I started with Pascal and later learned to write BASIC programs. Learning to program in Pascal took just a few hours—a few days at most. Had I started with BASIC, I believe I would have taken longer to reach a similar stage of proficiency. I will admit that since the two programs were written from the standpoint of a programmer who learned Pascal before BASIC, a comparison might be considered unfair by old hands at BASIC.

Trip Cost Estimator should be timely and of interest to anyone who uses a car in this time of high gasoline prices. The program asks you to enter a range of mpg (miles per gallon) estimates for the make of

Conversion to TRS-80

Here are a few changes to make if you wish to convert the Applesoft version of the program for TRS-80 use:

1. Delete one PRINT statement from lines 70, 120 and 170
2. Delete lines 150 and 190
3. Change line 180 to: GOSUB 820
4. Change HOME in line 320 to CLS
5. Change line 350 to read: CLS
6. Change line 470 to: GOSUB 820:CLS
7. Change line 680 to read: CLS
8. Change VTAB(10) to PRINT @450,""; in line 700
9. Change 2800 to 1000 in line 730
10. Change the 40 in line 750 to 63
11. Add line 820: INPUT" TO GO ON, HIT ENTER ";G$; RETURN

These changes will not allow a TRS-80 to generate hard copy. To do this, you will have to change the routine in lines 800 and 810. If you wish to run the program on the CRT only, you may delete lines 330, 340, 800 and 810.

Sample Run

```
]HOME

]RUN
        TRAVEL COST ESTIMATOR

                BY

            SAM GAYLORD
THIS PROGRAM WILL HELP YOU FIGURE
THE COSTS OF AN AUTOMOBILE TRIP,
GIVEN A RANGE OF ESTIMATED MPG'S
AND A RANGE OF PUMP PRICES - EACH
IN STEPS THAT YOU CHOOSE.

WHEN PROMPTED BY THE PROGRAM,
ENTER THE DATA REQUESTED. AND
BE CAREFUL TO ENTER GAS PRICES
AS CENTS (105, NOT $1.05).


HAVE A GOOD COMPUTER RUN --
HAVE A GOOD TRIP --
AND -- DRIVE CAREFULLY!


TO GO ON, HIT 'G' AND <RETURN> G


ENTER MPG BOUNDS:
    1) LOWER --> 28
    2) UPPER --> 32
    3) STEP  --> 2


ENTER PUMP PRICE BOUNDS (CENTS)
    1) LOWER --> 125
    2  UPPER --> 135
    3) STEP  --> 5

HOW LONG A TRIP? ENTER MILES 455

WANT HARD COPY? Y/N Y


HERE ARE COST ESTIMATES
FOR A TRIP OF 455 MILES
GIVEN THE FOLLOWING DATA:


    1) FUEL PRICES (CENTS/GAL.)
       FROM 125 TO 135
       IN STEPS OF 5 CENTS/GAL.


    2) ESTIMATED MPG RATES
       FROM 28 TO 32
       IN STEPS OF 2 MI./GAL.


MPG     PRICE     COST/MI      TRIP COST
-------------------------------------
 28     $1.25      .045         $20.48
 28     $1.3       .046         $20.93
 28     $1.35      .048         $21.84
 30     $1.25      .042         $19.11
 30     $1.3       .043         $19.57
 30     $1.35      .045         $20.48
 32     $1.25      .039         $17.75
 32     $1.3       .041         $18.66
 32     $1.35      .042         $19.11

-------------------------------------


WITH GAS AT $1.35 PER GALLON
AND YOUR CAR GETTING 28 MPG,
THE HIGHEST COST FOR THE 455 MILES
IS $21.84 AS AN ESTIMATE.
```

car you drive, together with a range of possible pump prices you might incur on an extended trip. You will also be asked to enter the total distance of your intended trip. Program output, via console or printer, displays a table of costs per mile and the total trip cost for each combination of gasoline price and mpg. Finally, the program shows you the "worst case" situation, which is the most costly combination you would have to deal with as based on your data.

A side-by-side study of the two listings and sample runs should help you decide whether Pascal affords an elegance and simplicity that puts BASIC to shame. I offer both versions of the program as an argument that Pascal is the ideal high-level language for newcomers to programming and personal computing. The programs can also serve as the basis for my prediction that Pascal, with its power and portability, its rigorous type checking of data, and its vigorous syntax and running speed, is destined to put BASIC into the dust of computer history.

The DS 180 provides a total package of performance features for any application where quality impact printing is required. Not a "hobby-grade" printer, the DS 180 is a real work-horse designed to handle your most demanding printer requirements.

High Speed Printing—Bidirectional printing at 180 cps offers throughput of over 200 lpm on average text. A 9-wire printhead generates a 9x7 font with true lower case descenders and underlining.

Non-volatile Format Retention—A unique keypad featuring a non-volatile memory makes programming the DS 180 quick and easy. Top of form, tabs, perforation skipover, communications parameters and many other features may be entered and stored from the keypad. The DS 180 even remembers the line where you stopped printing—eliminating the need to reset the top of form at power-on.

Communications Versatility—Interfaces include RS232, current loop and 8-bit parallel. Baud rates from 110-9600 may be selected. A 1K buffer and X-on, X-off handshaking ensure optimum throughput.

Forms Handling Flexibility—Forms ranging from 3"-15" may be fed from the front or bottom, and an adjustable printhead provides crisp and clear copy on forms with as many as 6-parts.

For more information on how the DS 180's low-cost total printer package can fill your application, contact us at Datasouth. The DS 180 is available for 30-day delivery from our sales/service distributors throughout the U.S.

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Take the Headaches Out of Tax Preparation

BY JOSEPH J. ROEHRIG

In the dark ages of the '70s, Aprils were trying times for taxpayers. People tried to complete the federal income tax forms by the April 15 deadline aided solely by handheld calculators. What a difference in the '80s with the mighty micros ready to lend a hand.

If you have a Level II TRS-80 with 16 kilobytes of memory, this article will give you all the software you need to prepare the Internal Revenue Service's Form 1040 with Schedules A and B, and it will give you income averaging to boot. If you are fortunate enough to have a 32-kilobyte disk system for the TRS-80, you get Schedule C, too, and can make the computer print the data in a form suitable for submission to the IRS.

You say preprinted blank IRS forms are expensive? They are if you buy them in bulk at $75 a box for 1500 copies of a form. But read on, and you'll see how I got all of the forms I needed for $3.75.

You want still more? O.K., you'll learn how the programs work so you can alter them for future use, when tax rates, forms and laws change. Now let's get on with it.

Running the package

Before we get into the nitty gritty, load program "T" (see listing on p. 90) into your computer. For TRS-80 disk users, you must specify three files and 48000 for memory when entering BASIC.

Program "T" has 14 action codes, as can be seen in lines 71 through 76. Let's begin with code 13, which starts a new file. After code 13 is entered, the program solicits such

```
A LINE NUMBER OR ALL TO INPUT ALL LINES  ? ALL
INPUT AMOUNT FOR LINE 1-5  F. STATUS     ? 2
INPUT AMOUNT FOR LINE 6-7  EXEMPTION     ? 3
INPUT AMOUNT FOR LINE   8  WAGES         ? 20000
INPUT AMOUNT FOR LINE   9  INTEREST      ? 100
INPUT AMOUNT FOR LINE 10A  DIVIDENDS     ? 100
INPUT AMOUNT FOR LINE 10B  EXCLUSION     ? 200
INPUT AMOUNT FOR LINE  56  1979 E PAY    ? 0
INPUT AMOUNT FOR LINE  57  EARN INC CR   ? 0
INPUT AMOUNT FOR LINE  58  PAID ON 4868  ? 0
INPUT AMOUNT FOR LINE  59  EXCESS FICA   ? 0
INPUT AMOUNT FOR LINE  60  CR ON FUELS   ? 0
INPUT AMOUNT FOR LINE  61  REG CO CREDI  ? 0
INPUT AMOUNT FOR LINE  65  CREDIT TO 80  ? 0
```

Figure 2—User selects action code 5 and enters into Form 1040. User also enters "ALL" for all line numbers; program solicits input.

```
NAME       ? MR & MRS JOHN Q PUBLIC
ADDRESS 1/2? ANY NUMBER YOUR STREET
ADDRESS 2/2? MY TOWN  HIS STATE ZIP' ZIP
SS# 1      ? 012-34-5678
SS# 2      ? 901-23-4567
OCCUPAT. #1? WRITER
OCCUPAT. #2? PROGRAMMER



FILING STATUS 1 TO 5? 2
ANSWER Y FOR YES OR N FOR N
#1 $1-CAMP.? Y
#2 $1-CAMP.? N
#1 ARE YOU OVER 65? N
#1 ARE YOU BLIND? N
#2 ARE YOU OVER 65? N
#2 ARE YOU BLIND? N



HOW MANY DEPENDENT CHILDREN? 1
THEIR NAMES? MY BABY
HOW MANY OTHER DEPENDENTS? 0
```

Figure 1—Action code 13 is selected, and the computer solicits the data.

```
A LINE NUMBER OR ALL TO INPUT ALL LINES  ? 1
GIVE YOUR INPUT FOR 'INSURANCE    ' ? 150
RETURN TO END OR A LINE NUMBER TO CONTINUE ? 6A
GIVE YOUR INPUT FOR 'DOC, DENT, N' ? 200
RETURN TO END OR A LINE NUMBER TO CONTINUE ? 11
GIVE YOUR INPUT FOR 'STATE & L IN' ? 1100
RETURN TO END OR A LINE NUMBER TO CONTINUE ? 12
GIVE YOUR INPUT FOR 'REAL ESTATE ' ? 1200
RETURN TO END OR A LINE NUMBER TO CONTINUE ? 13
GIVE YOUR INPUT FOR 'GEN SALES    ' ? 1300
RETURN TO END OR A LINE NUMBER TO CONTINUE ? 17
GIVE YOUR INPUT FOR 'HOME MORTG   ' ? 2000
RETURN TO END OR A LINE NUMBER TO CONTINUE ? 18
GIVE YOUR INPUT FOR 'CRED. CARDS ' ? 100
RETURN TO END OR A LINE NUMBER TO CONTINUE ? 19
THE NAME OF THIS LINE ? MARGIN ACC'T
```

Figure 3—Input into Schedule A is generated by action code 7. Certain line numbers require that words be input instead of numbers.

data as name, address, dependents and the all-important Social Security number. Messages and sample inputs are shown in Figure 1 for Mr. and Mrs. John Q. Public. Why such detail? You can use these programs to become an entrepreneur and create a file for each of your clients.

Now let's move on and see how to enter data into the program.

Entering the data

To fill out Form 1040, choose option 5. All data are entered via IRS form line number. However, the computer will not accept inputs for line numbers that can be calculated (1% of gross, 3% of gross, etc.—these are totals or subtotals). Nor will it accept lines from other forms calculated by the program—namely, Schedules A, B and C. Any other line can be entered.

If your return requires Schedule D or any other form not provided by this package, simply complete that form manually and enter the results on the line via the 1040 input option.

Figure 2 shows John Q's 1040 information being entered. The input program has two modes: one for specific individual line numbers, as already discussed, and one for all lines. In Figure 2, the "ALL" mode was selected, and the program asked for an input for each valid line number. With this mode, you do not even have to know the line numbers.

Suppose you make a mistake—say, John Q. earned $21,000, not $20,000 in our example. Do we have to re-enter all the information? No. Merely enter action code 5 again, but this time enter the specific line 8 and then $21,000. Does the computer know what line numbers are valid for each form? Yes. If you try to enter data for a nonexistent line, an error message is generated.

Figure 3 shows the same input procedure for Schedule A, with one new wrinkle: certain line numbers require that words be input instead of numbering. The program provides for this, as can be seen in Figure 3, where line 19 for Schedule A was entered. The program asked for the name of the line, and "Margin Acc't" was supplied. Schedules B and C are handled in a similar manner.

One last point on entering data: The filing status and exemptions are calculated during action code 13's question and answer session.

```
YOUR TAX SUMMARY IS

TOTAL TAXES    2538.00
TOTAL PAY.     4500.00
BALANCE       -1962.00

READY?
```

4a

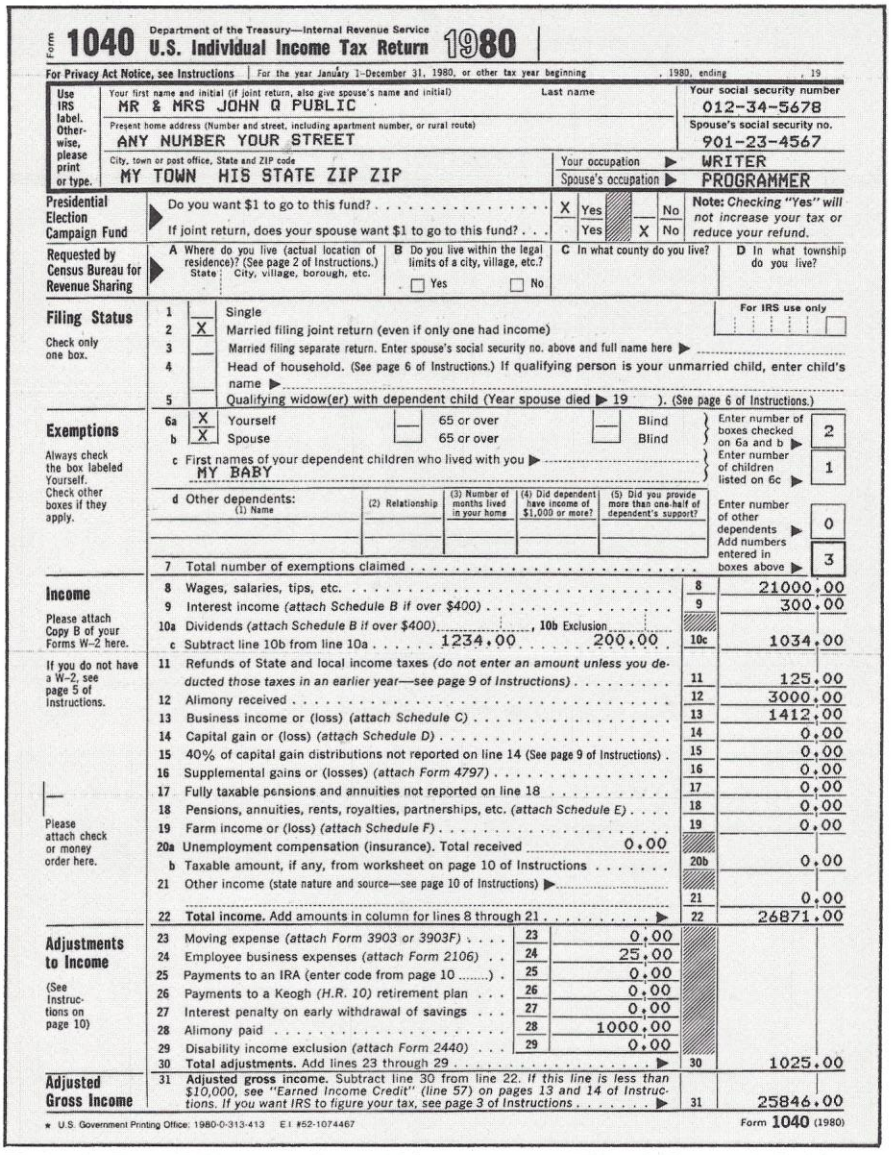
```
THIS SECTION ONLY WORKS IF YOU HAVE SAME FILING
STATUS FOR THE LAST FIVE YEARS
GIVE TAXABLE INCOME FOR YEARS 1976
ADD 3200 IF MARRIED, 1600 IF MARRIED FILING SEPARATELY
2200 IF SINGLE OR HEAD OF HOUSEHOLD
TO EACH OF THESE YEARS? 5000
GIVE TAXABLE INCOME FOR YEARS 1977,1978,1979?
LESS 750 FOR EACH DEDUCTION CLAIMED IN
EACH OF THESE YEARS? 10000,15000,20000

YOUR TAX IS   2733.30 IF YOU INCOME AVERAGE
VERSUS   2799.00 IF YOU DON'T

READY?
```

4b

Figure 4—Code 3, a tax summary, and code 4, income averaging, are used here. Note: "Total taxes" of $2538 differs from the $2799 computed without income averaging.

```
MR & MRS JOHN Q PUBLIC                                    012-34-5678

ANY NUMBER YOUR STREET                                    901-23-4567
                                                          WRITER
MY TOWN  HIS STATE ZIP ZIP                                PROGRAMMER
                                          X

                                                  X



        X



        X
        X                                                          2

     MY BABY                                                       1


                                                                   0

                                                                   3
                                                            21000.00
                                                              300.00

                                  1234.00       200.00       1034.00

                                                              125.00
                                                             3000.00
                                                             1412.00
                                                                0.00
                                                                0.00
                                                                0.00
                                                                0.00
                                                                0.00
                                                                0.00
                                                  0.00
                                                                0.00

                                                                0.00
                                                            26871.00
                                                  0.00
                                                 25.00
                                                  0.00
                                                  0.00
                                                  0.00
                                               1000.00
                                                  0.00
                                                             1025.00

                                                            25846.00
```

Figure 5—Form 1040 printed on blank sheet of paper corresponds to the spacing found on IRS Form 1040.



Form **1040** Department of the Treasury—Internal Revenue Service **U.S. Individual Income Tax Return 1980**

For Privacy Act Notice, see Instructions. For the year January 1–December 31, 1980, or other tax year beginning , 1980, ending , 19

Use IRS label. Otherwise, please print or type.
Your first name and initial (if joint return, also give spouse's name and initial): MR & MRS JOHN Q PUBLIC
Last name
Your social security number: 012-34-5678
Present home address (Number and street, including apartment number, or rural route): ANY NUMBER YOUR STREET
Spouse's social security no.: 901-23-4567
City, town or post office, State and ZIP code: MY TOWN HIS STATE ZIP ZIP
Your occupation ▶ WRITER
Spouse's occupation ▶ PROGRAMMER

Presidential Election Campaign Fund
Do you want $1 to go to this fund? X Yes No
If joint return, does your spouse want $1 to go to this fund? Yes X No
Note: *Checking "Yes" will not increase your tax or reduce your refund.*

Requested by Census Bureau for Revenue Sharing
A Where do you live (actual location of residence)? (See page 2 of Instructions.) State City, village, borough, etc.
B Do you live within the legal limits of a city, village, etc.? ☐ Yes ☐ No
C In what county do you live?
D In what township do you live?

Filing Status (Check only one box.)
1 ☐ Single
2 X Married filing joint return (even if only one had income)
3 ☐ Married filing separate return. Enter spouse's social security no. above and full name here ▶
4 ☐ Head of household. (See page 6 of Instructions.) If qualifying person is your unmarried child, enter child's name ▶
5 ☐ Qualifying widow(er) with dependent child (Year spouse died ▶ 19). (See page 6 of Instructions.)
For IRS use only

Exemptions (Always check the box labeled Yourself. Check other boxes if they apply.)
6a X Yourself ☐ 65 or over ☐ Blind
b X Spouse ☐ 65 or over ☐ Blind
Enter number of boxes checked on 6a and b ▶ 2
c First names of your dependent children who lived with you ▶ MY BABY
Enter number of children listed on 6c ▶ 1

d Other dependents: (1) Name	(2) Relationship	(3) Number of months lived in your home	(4) Did dependent have income of $1,000 or more?	(5) Did you provide more than one-half of dependent's support?

Enter number of other dependents ▶ 0
Add numbers entered in boxes above ▶ 3
7 Total number of exemptions claimed . . . 3

Income (Please attach Copy B of your Forms W-2 here. If you do not have a W-2, see page 5 of Instructions. Please attach check or money order here.)

8	Wages, salaries, tips, etc.	8	21000.00
9	Interest income (attach Schedule B if over $400)	9	300.00
10a	Dividends (attach Schedule B if over $400) 1234.00 ; 10b Exclusion 200.00		
10c	Subtract line 10b from line 10a	10c	1034.00
11	Refunds of State and local income taxes (do not enter an amount unless you deducted those taxes in an earlier year—see page 9 of Instructions)	11	125.00
12	Alimony received	12	3000.00
13	Business income or (loss) (attach Schedule C)	13	1412.00
14	Capital gain or (loss) (attach Schedule D)	14	0.00
15	40% of capital gain distributions not reported on line 14 (See page 9 of Instructions)	15	0.00
16	Supplemental gains or (losses) (attach Form 4797)	16	0.00
17	Fully taxable pensions and annuities not reported on line 18	17	0.00
18	Pensions, annuities, rents, royalties, partnerships, etc. (attach Schedule E)	18	0.00
19	Farm income or (loss) (attach Schedule F)	19	0.00
20a	Unemployment compensation (insurance). Total received 0.00		
b	Taxable amount, if any, from worksheet on page 10 of Instructions	20b	0.00
21	Other income (state nature and source—see page 10 of Instructions) ▶	21	0.00
22	**Total income.** Add amounts in column for lines 8 through 21 ▶	22	26871.00

Adjustments to Income (See Instructions on page 10)

23	Moving expense (attach Form 3903 or 3903F)	23	0.00		
24	Employee business expenses (attach Form 2106)	24	25.00		
25	Payments to an IRA (enter code from page 10 .....)	25	0.00		
26	Payments to a Keogh (H.R. 10) retirement plan	26	0.00		
27	Interest penalty on early withdrawal of savings	27	0.00		
28	Alimony paid	28	1000.00		
29	Disability income exclusion (attach Form 2440)	29	0.00		
30	**Total adjustments.** Add lines 23 through 29 ▶			30	1025.00

Adjusted Gross Income

31	**Adjusted gross income.** Subtract line 30 from line 22. *If this line is less than $10,000, see "Earned Income Credit" (line 57) on pages 13 and 14 of Instructions. If you want IRS to figure your tax, see page 3 of Instructions* ▶	31	25846.00

* U.S. Government Printing Office: 1980-0-313-413 E.I. #52-1074467 Form **1040** (1980)

Figure 6—Form 1040, page 2, generated from Program "F" and photocopied with an overlay. Overlays can be made by your local print shop.

```
1 REM DELETE LINES 125-141;363-368 AND 4000-4038
5 CLEAR 3200
10 DIM I(122),I$(122),L$(122),T(3,17,2),T1(3,1)
100 CLS
110 INPUT"TURN ON CASSETTE";Z$
120 FORA=1TO122:INPUT#-1,I(A):NEXT
180 GOTO 70
360 CLS:INPUT"TURN ON CASSETTE";Z$
362 FORA=1TO122:PRINT #-1,I(A):NEXT
374 GOTO 70
800 GOTO 70
900 GOTO 70
7000 RETURN
```

Figure 7—Changes to allow program to run on a cassette-based, 16K Level II TRS-80 computer system.

This program is available for TRS-80, Northstar and Apple from JJR Data Research, P.O. Box 74, Middle Village, NY 11379; (516) 643-1931. Cassette: $7; Disk $10.

However, inputs into the 1040 section can override this calculation. As we saw in Figure 2, the first two questions asked when all line numbers were being entered were: "F. Status?" and "Exemptions?." The valid line number for filing status is called "1-5", and for exemptions the line is called "6-7" when the 1040 input is used.

Total taxes at a glance

Action code 3 (Figure 4a) shows the total tax bill less taxes paid, yielding a credit balance, or refund of $1962. Action code 4 (Figure 4b) does income-averaging. Just enter the requested data covering the last four years, and you have your results.

Note that the total tax shown comes from line 54 of Form 1040. This represents a gross tax of $2799 (from line 37) less John Q's $150 investment tax credit and $111 energy credit.

Any of the four forms (1040, Schedules A, B and C) can be displayed on the video screen or can be duplicated by the printer in worksheet form. The data are displayed a screen at a time with an ending message: "P/C?." A "C" input clears the screen and displays the next screen. "P" directs the screen to the printer before displaying the next screen.

Using data files

Before leaving program "T" you ought to know about action codes 1 and 2. They read and save files. After John Q's tax return is finished, we save the data by using action code 2 and designating a file name—say, "PUBLIC J Q." If we did not save the data, all of the information would have to be re-entered to perform any other work on John Q's return. In addition, we would not have any data to run our next tax program, which prints the data on forms.

The data are valuable because corrections can be made easily at this point. Let's say you have completed your entire return and the next day you receive a forgotten interest statement. Merely load the program, use action code 1 to read the data already entered, and you are ready to make a quick correction. Another handy use for the magnetically recorded data is to save it twice and

```
55 L$(A)=RIGHT$(Z$,3)
56 LPRINT USING"$$$ % % %
57 Y=0:LPRINT" "
58 NEXTA:END
A;L$(A);I$(A);:Y=Y+1:IFY<3THEN58
```

Figure 8—Four lines of code that, when added to Program "T," reveal the 177 values of I(177).

use the second file as a pro forma return for the current year. You merely enter more up-to-date estimates and information as they become available for the current year, and you have a current tax forecasting system.

Printing on forms

As mentioned earlier, unless you are in the tax preparation business, it is expensive to purchase preprinted blank tax forms. Program "F" prints all of the tax information in the proper manner to use these preprinted forms, but how do we use the program at a reasonable cost?

We merely take all of your blank IRS tax forms to a printer and ask him to make transparencies. Transparencies are clear photocopies of the forms. My local printer made the necessary copies of the five forms (two sides of Form 1040 and one side each of Schedules A, B and C) for 75¢ apiece, or $3.75.

Now all you have to do is run Program "F" using plain computer paper. The next step is to lay the transparency over the computer printout, and the numbers should line up according to the form. Next photocopy the printout with the transparency on top of the final form, and it looks as if the data were printed on it.

Granted, this is a lot of work for printing one tax return. But if you are working on five, six or more returns, this is an economical way to file computer-generated tax forms.

Program "F" has its own selection of action codes. Code 1 is used first; it reads a file. After a file is read, any of the five tax forms can be printed either once or numerous times. If you are filing many returns, and have preprinted IRS forms, the computer can read a file; print a Form 1040, read another file; print the next 1040, etc. This procedure would avoid constant loading of different preprinted forms.

Figure 5 shows page 1 of a 1980 Form 1040 printed on a plain piece of computer paper. The spacing differs from the 1979 form, but contains the same line numbers. Figure 6 shows page 2 of Form 1040 printed on the same plain paper, but this time the transparencies were used before it was photocopied.

How do we convert the program to run on a cassette system? Just delete the lines indicated in Figure 7 and add the program lines shown.

Single Schedule X

Actual Table				Program Representation				
Over	Not Over	Tax	% of Excess	Variable	Line Number	Y1 Over	Y2 Tax	Y3 %
				T(0,0,Y)	5000	0	0	0
2300	3400	0	14%	T(0,1,Y)	5000	2300	0	0
3400	4400	154	16%	T(0,2,Y)	5001	3400	0	.14
4400	6500	314	18%	T(0,3,Y)	5002	4400	154	.16

Figure 9—Data for the tax calculation routine in Program "T" are stored in variable T as illustrated above.

FORM Program Listing

```
5 CLS
10 PRINT"SET PRINTER TO TOP OF PAGE AND"
15 INPUT"ENTER THE NUMBER OF FORMS YOU WANT ";Z
18 FOR B=1TOZ
20 FOR A=1TO66
30 LPRINT USING"##";A;
40 LPRINT "  :X::::1::::X::::2::::X::::3::::X::::4";
50 LPRINT ":::::X::::5::::X::::6::::X::::7::::X::::8::::X";
60 LPRINT ":::::9::::X::::0::::X::::1::::X::::2::::X::::3"
70 NEXT
75 NEXT
80 PRINT"YOUR SAMPLE FORM HAS BEEN PRINTED"
90 END
```

Maintaining your programs

If you want to add tax forms, update for future years, or just have some typos when entering the listings, here is some helpful information. First, what are the variables? Take your program "T" and add the four lines shown in Figure 8. This will print the subscript number, tax form line number and the name for the program's key variable I(177).

The main thing that has to be maintained in program "T" is the tax calculation routine. These data are stored in the array variable T(3, 17, 2). The first dimension is 0 for the "single" tax rate on Schedule X, 1 for "joint returns" tax rate on Schedule Y, 2 for "married taxpayers filing separately" and 3 for the "head of the household" tax rate on Schedule Z. The second dimension, 17, corresponds to the different steps of the tax rate schedule. The last dimension is used as follows: 0 is the highest taxable income for the classification, 1 is the tax for the particular bracket, and 2 is the percentage to be used on the excess over the base. This variable is dimensioned on line 10, read on line 60, and the data are on lines 5000 to 5313.

Subroutine 8500 is used to calculate the tax. To experiment with new tax rates, add a line 65 that calls for the input of a taxable amount and then goes directly to subroutine 8500. This is how the tax tables are verified.

Program "F" does the format printing. The 200 lines print page 1 of Form 1040 and page 2 of that form; the 400 lines print Schedule A, the 500 lines Schedule B and the 600 lines Schedule C. Each section produces exactly 66 lines of print—the exact length of a computer page.

The majority of the numbers and tabs are printed via subroutines 9100 to 9900. For example, 9100 prints one number in the far right, 9200 prints one number three-quarters of a page over, etc. These subroutines use S to correspond to the value of I(177), which is to be printed. S1 is used if two values are required.

Program "FORM" is a brief one that prints a worksheet that numbers all of the columns and lines of a standard computer page.

Good luck and many happy returns—tax returns, that is. □

Choosing An Assembler For Machine Language Programming

BY TOD ZIPNICK

Machine language programs often run 10 times faster and require less memory than equivalent programs in BASIC. But learning to program in machine language can be difficult. Yet it needn't be. Success depends to a large extent on the tools you use. One of the most important tools available to you is an assembler.

An assembler is like an interpreter accompanying a foreigner in a strange country. Just as the interpreter translates information from one language into another, the assembler program takes English-like instructions and converts them into a language that a microprocessor can understand.

To talk to a microprocessor, which is the heart of your personal computer, you must communicate in a language composed of hexadecimal numbers. These include the standard decimal set, 0 through 9, and six more numbers, 10 through 15, which are represented by the letters A through F. Whereas 10 is the base of the number system that most people deal with, 16 is the base of the number system that personal computers use.

Working with code words

Programming directly in hexadecimal numbers would be very hard. To obviate this, the manufacturers of microprocessors used in personal computers have produced sets of code words that can easily be converted into hexadecimal numbers. These code words are called *mnemonics,* and there is one mnemonic for each instruction that the microprocessor recognizes. Here is where the assembler comes into play. It translates mnemonics into hexadecimal language.

Mnemonics are like the key words in a BASIC program. Each has a specific meaning and a task to perform. However, the mnemonics differ from one microprocessor to another, as does the actual instruction set. Thus the programs developed for one microprocessor, such as the Z80 used in the TRS-80 computer, cannot be used with another microprocessor, such as the 6502 used in the Apple II, without being completely rewritten.

Many assemblers are available today to convert mnemonic code words into hexadecimal language. There are, of course, different assemblers for the different microprocessors. But even for a single microprocessor, there could be as many as a dozen different assemblers available. Besides their translation function, all have additional features that can make programming easier.

When using an assembler, the programmer will also usually use some form of text editor to write the program. The written program is, as noted, an arrangement of mnemonics in a particular way. This is called the *source listing.* When the assembler converts this listing into hexadecimal numbers, the resulting program is known as the object code. This is the actual program the computer runs.

Modular and combined types

There are several ways to prepare the source code of a program for the assembler. Some systems use a modular approach in which the text editor and assembler are separate. Here the text editor prepares the source code, and the code is either stored in memory or on disk for later use by the assembler. Another technique employs one program, a combination assembler/text editor, which not only can generate and modify source programs, but also can assemble them into object code. When this method is used, the text editor will generally leave the source code in a protected area of memory called a buffer, where the assembler portion of the program finds it.

In general, there are two types of assemblers: memory-oriented and disk-oriented. A combined assembler/editor is frequently memory-oriented, while the modular

Before you purchase an assembler, know its characteristics.

assembler and editor is often disk-oriented. The distinction between the two is not always clear. There are, for example, modular assemblers that are memory-oriented. There are also combined editor/assembler units that fetch the source code from memory, but can also fetch additional source files from a disk.

The object code generated by the assembler can be stored in one of two ways: in memory, or on a disk or tape. As you can see, it is possible to have a completely disk-oriented assembler, where the source code is obtained from one disk file and the generated object code is stored on another.

Selecting an assembler

Before you buy an assembler, you ought to know some essentials about it. Begin with the text editor.

Does the assembler come with a built-in text editor or do you have to provide one? If it comes with an editor, how good is the editor? Is the editor a cursor-based screen type or a line editor? (Screen editors are often easier to use.) Does the editor have search capability? How about search and replace capability? Does it have a delete buffer that temporarily stores deleted text, in case you change your mind and wish to recover the deleted material?

Can whole sections of text be moved around easily by the editor? And duplicated? (These features come in handy if certain sections of code are repeated in your program.) Does the editor accept source code in a free-form input, or must information be entered only in specific column locations? (Free-form input is faster and less prone to error.) Does the editor allow long comments to be entered? (Most do.)

Once you've checked out the text editor, consider the features of the assembler itself.

What is the maximum length the assembler allows for labels? (When you write a program, you will generally divide it into small sections, which you will label.) The longer the label, the more descriptive it can be. Length varies between four and 10 characters, with six the most common length available. Does the assembler permit local and global labels? (If it does, you can use the same local label several times when a similar, but different, action is being

```
                        ; ***********************************
                        ; *                                 *
                        ; * SAMPLE ASSEMBLY LANGUAGE PROGRAM *
                        ; *                                 *
                        ; ***********************************
                        ;
                        ;
                        ; ZERO PAGE EQUATES
                        ;
                        *TEMP    =20
                        ;
                        ;
                        ;
                        ; EQUATES
                        ;
                        *HOME    =FC58
                        *PRINT   =FDED
                        ;
                        ;
                        ;
                        ; PRINT OUT FIRST TEST MESSAGE
                        ;
$0300: 20 58 FC         *START   JSR *HOME        ; CLEAR SCREEN
$0303: A0 00                     LDY #$0          ; ZERO COUNTER
$0305: B9 12 03         LOOP     LDA TEXT,Y       ; GET MESSAGE
$0308: C9 A3                     CMP '#           ; END OF TEXT?
$030A: F0 26                     BEQ *NEXT        ; YES, CONTINUE
$030C: 20 ED FD                  JSR *PRINT       ; NO, PRINT IT
$030F: C8                        INY              ; INCREASE CNT
$0310: D0 F3                     BNE LOOP         ; GET NEXT CHR.
$0312:                  TEXT     "THIS IS TEST MESSAGE NUMBER 1]]
                        #"
                        ;
                        ;
                        ; PRINT OUT SECOND TEST MESSAGE
                        ;
$0332: A0 00            *NEXT    LDY #$0          ; ZERO COUNTER
$0334: B9 41 03         LOOP     LDA TEXT,Y       ; GET MESSAGE
$0337: C9 A3                     CMP '#           ; END OF TEXT?
$0339: F0 26                     BEQ *MORE        ; YES, CONTINUE
$033B: 20 ED FD                  JSR *PRINT       ; NO, PRINT IT
$033E: C8                        INY              ; INCREASE CNT
$033F: D0 F3                     BNE LOOP         ; GET NEXT CHR.
$0341:                  TEXT     "THIS IS TEST MESSAGE NUMBER 2]]
                        #"
                        ;
                        ; THIS PART OF THE PROGRAM STORES A
                        ; NUMBER ON ZERO PAGE AND COPIES ONE
                        ; TABLE THAT IS 6 BYTES LONG INTO
                        ; ANOTHER PART OF MEMORY.
                        ;
$0361: A9 30            *MORE    LDA #$30
$0363: 85 20                     STA *TEMP
$0365: A0 05                     LDY #$5
$0367: B9 74 03         LOOP     LDA TABLE1,Y     ; GET DATA
$036A: 99 7A 03                  STA TABLE2,Y     ; STORE IT
$036D: 20 ED FD                  JSR *PRINT       ; PRINT IT OUT
$0370: 88                        DEY              ; LOWER COUNT
$0371: 10 F4                     BPL LOOP         ; GET MORE DATA
$0373: 00                        BRK              ; STOP
$0374:                  TABLE1   .C6 C5 C4 C3 C2 C1
$037A: 00               TABLE2   BRK
```

Many of the features of an assembler can be determined by looking at a sample program written with it. In the listing above, the labels LOOP and TEXT are used more than once. This is an indication that the assembler supports local and global labels, where LOOP and TEXT are local labels. In this assembler, global labels are preceded by an asterisk. The method of entering ASCII data in a program varies with the assembler. Some allow you to place the text within quotation marks as this one does, others require the use of a pseudo op code such as ASC.

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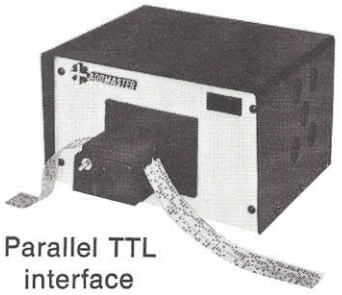

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performed in different parts of the program.) If this feature is not available, you'll have to use different names for the various program sections. This is easy if you're not concerned with keeping the labels descriptive—otherwise it's quite a bit more difficult.

Will the assembler use the standard mnemonics devised by the manufacturer of your microprocessor? Some assemblers will not. This is particularly true for the Zilog Z80 microprocessor. When an assembler substitutes its own mnemonics for those of the microprocessor manufacturer, the latter's literature on how to program the processor will be far less useful to you than it could be.

Relocating and linking codes

Does the assembler produce relocatable code? In general, when a program is assembled to operate in a particular area of memory, that is the only place where it can operate. The reason is that the different sections of the same program are not independent but part of a coherent whole. One section usually contains references to other sections, and the assembler must be able to locate them all. This is only possible if the program is residing in the area of memory for which it was intended.

automatically takes information provided by the relocating assembler and adjusts the modules so they can operate in the desired memory location.

This technique can be quite useful. First, if part of a program must be changed, only the module containing the code to be changed need be edited and reassembled. Once that is done, the whole program is simply connected together again from scratch. An additional advantage of the relocating assembler is that it can be used to create a library of commonly used subroutines. Module libraries are extremely useful when large groups of programs are written. The source code for a particular function need be stated but once, and any change in the code will automatically be effected system-wide.

Making your own mnemonics

Are macros available? Some assemblers permit programmers to define their own mnemonics. Such mnemonics are referred to as *macros* and generally consist of short segments of code that are used frequently throughout a program. Macros help keep down the length of a program. They are in many respects similar to modules, except that macros are part of the program being written, while modules have to be pulled in from a disk. In general, macros are shorter than modules.

Relocatable assembly code offers programming flexibility.

However, it is possible to create machine language code that can be run anywhere in memory. This is known as relocatable code. A programmer can generate relocatable code by using only a limited number of available microprocessor commands, or by using an assembler that produces relocatable code. With such an assembler, individual modules of machine language code are produced, and these are connected later for use by a program called a *linker*. The linker

When a source program is being assembled, there is certain information that the assembler itself must know. It must know where the program is supposed to run in memory and where it will be stored temporarily. Sometimes these two places are the same. It has to know if certain information in the source code is to be treated as ASCII information, hexadecimal information, a

Comparative Features of Various Assemblers

	Apparat Assembler	Apple MAC	Apple Assembler	Microsoft Assembly Language Development System	ASM 65	Atari Assembler	Editor Assembler Plus	Hayden Assembly Language Development System	LISA	MAC Assembler	Microproducts Assembler	M80 for CP/M	SC Assembler 2	TED 2
1. Has Editor	●		●	●	●	●	●	●	●		●	●	●	●
2. Has Linker		●		●								●		
3. Has Library Manager		●										●		
4. Disk-based		●	●	●				●		●		●		
5. Semi-disk-based		●		●	●			●	●	●		●	●	
6. Assembles Multiple Files		●	●	●	●				●	●		●	●	
7. Source stored on cassette	●					●	●							
8. Source stored on disk	●	●	●	●		●		●	●	●		●		
9. Object assembled to cassette	●						●							
10. Object assembled to disk	●	●	●	●	●				●	●		●		
11. Supports Macros		●		●			●	●		●		●		
12. Supports Conditional Assembly		●	●	●			●		●	●		●		
13. Supports Program Libraries														
14. Supports Macro Libraries		●		●				●		●		●		●
15. Supports Object Code Libraries		●		●								●		
16. Produces Absolute Code	●		●		●	●	●	●	●	●	●		●	●
17. Produces Relocatable Code		●	●	●								●		
18. Supports Global Symbols		●		●		●		●				●		
19. Uses Standard Mnemonics	●	●	●	●	●	●	●	●	●	●	●	●	●	●

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byte, a word, etc. This information is conveyed to the assembler through a separate set of instructions that are often called *psuedo-ops*. The number of pseudo-ops provided by assemblers varies widely, but in general, the more there are, the more flexible the assembler is.

The ideal storage

How are source programs stored? After you have written a machine language program with your assembler, you almost certainly will want to store it on some magnetic media, probably a floppy diskette. Different assemblers use different storage techniques. Frequently, sequential text or ASCII files are utilized. Depending on the computer used, this can be a slow way to store and re-enter data. A faster way in many cases is to use a binary file. Here the source program is generally stored in memory and then transferred to a disk or tape in the form of a binary file.

The ideal assembler should be able to store and enter data either way, so it will not be a major task to convert files from one assembler to another.

One additional factor that you might want to consider when buying an assembler: Is a compatible disassembler available? A disassembler simply does the reverse of an assembler. It takes object code and attempts to reconstruct a source file from it. Good disassemblers examine the object code several times and produce a source listing with labels. Generally these labels take the form of an "L" followed by the numbers that designate the memory location of that label. An example would be L9533, where 9533 is the hexadecimal location of the label.

Once source code is generated by the disassembler, it is frequently written out as a file that is completely compatible with the assembler for which it is meant.

Disassemblers are convenient if you wish to modify a section of existing machine language code and its source listing is not available. But be aware of one thing: imbedded message tables or raw hexadecimal data can seriously foul up any attempt to correctly disassemble machine language programs. □

Need more information?

For more information on Assemblers readers may consult the software producers and publishers listed here by circling the appropriate numbers on the reader-service card.

Apple MAC (Z80)—Microsoft 400 108th Ave., N.E. Suite 200 Bellevue, WA 98004, (206) 454-1315 **Circle 221**

Apple Assembler (6502)—Apple Computer, 10260 Bandley Dr., Cupertino, CA 95014, (800) 538-9696 **Circle 222**

Microsoft Assembly Language Development System—See address shown above for Microsoft.

ASM 65 (6502)—Programma International, 2908 N. Naomi St., Burbank, CA 91504, (800) 423-2978 **Circle 223**

Atari Assembler (6502)—Atari Consumer Division 1265 Borregas, Sunnyvale, CA 94086, (800) 538-8547 **Circle 224**

Editor Assembler Plus (Z80)—See address shown above for Microsoft.

Hayden Assembly Language Development System (6502)—(Hayden Book Co., 50 Essex St., Rochelle Park, NJ 07662, (201) 843-0550 **Circle 225**

LISA (6502)—See address shown above for Programma International.

MAC Assembler (8080)—Digital Research P.O. Box 579, Pacific Grove, CA 93950, (408) 649-3896 **Circle 226**

Microproducts Assembler (6502)—Microproducts 30420 Via Rivera, Rancho Palos Verdes, CA 90274, (213) 541-5131 **Circle 227**

M80 for CP/M (Z80)—See address shown above for Microsoft.

Apparat Assembler (Z80)—Apparat, Inc. 7310 E. Princeton, Denver, CO 80222, (303) 758-7275 **Circle 228**

SC Assembler 2 (6502)—SC Software P.O. Box 5537, Richardson, TX 75080 **Circle 229**

TED 2 (6502)—A.P.P.L.E. 304 Main Ave. S., Suite 300, Renton, WA 98055, (206) 271-4514 **Circle 230**

SOME STRAIGHT TALK ABOUT DISK DRIVES

- DON'T BE CONFUSED BY ALL THE BRAND NAMES YOU SEE IN THE MARKET PLACE, THERE ARE VERY FEW MANUFACTURERS OF THE BASIC DRIVE CHASSIS, ALL THE OTHER NAMES ARE THOSE OF THE ASSEMBLERS OR THE RETAILERS.
- AS MANUFACTURED, THE DRIVE WILL NOT RUN ON A TRS-80$, IT MUST BE MODIFIED BY THE ASSEMBLER.
- THE QUALITY OF THE DRIVE DELIVERED TO YOU IS DEPENDENT ON BOTH THE MANUFACTURER AND THE ASSEMBLER, THE BEST CAN TURN TO JUNK IF THE ASSEMBLY IS IMPROPERLY DONE.
- THE POWER SUPPLY AND CASE ARE VERY IMPORTANT COMPONENTS OF THE COMPLETE DRIVE, THE CASE MUST ALLOW PROPER COOLING AIR FLOW, AND THE POWER SUPPLY MUST MAINTAIN TWO CONSTANT VOLTAGES.
- YOU MUST DEPEND ON THE COMPANY SELLING YOU THE DRIVE TO SERVICE IT AT REASONABLE COST WHEN IT FAILS YOU, THE MANUFACTURER IS NOT EQUIPPED TO DO THIS!
- THE BEST MEASURE OF QUALITY IN A DRIVE IS IT'S SPECIFICATIONS, WILL IT HANDLE DOUBLE DENSITY, WHAT IS THE TRACK TO TRACK ACCESS TIME, THE ANSWERS TO THESE TWO QUESTIONS INDICATE THE PRECISION OF IT'S COMPONENTS.
- WHAT KIND OF DRIVE SHOULD YOU BUY ? LEVEL IV HAS CHOSEN TO DISTRIBUTE EXCLUSIVELY, THE MPI LINE, ALL MODELS OF MPI ARE DOUBLE DENSITY RATED AND REQUIRE ONLY A FIVE MILLI-SECOND TRACK TO TRACK ACCESS TIME.
- WHAT DO ALL THE MODEL NUMBERS MEAN?
  B-51= 40 TRACKS SINGLE HEAD SINGLE SIDE B-52= 40/40 TRACKS DOUBLE HEAD DOUBLE SIDE
  B-91= 80 TRACKS SINGLE HEAD SINGLE SIDE B-92= 80/80 TRACKS DOUBLE HEAD DOUBLE SIDE
  (DOUBLE HEADS)-READ BOTH SIDES OF DISK (DUALS)-TWO DRIVES IN ONE CASE (RAW)-NO POWER SUPPLY OR CASE
- WHERE SHOULD YOU BUY YOUR DRIVE, LEVEL IV IS ONE OF THE OLDEST AND LARGEST DISTRIBUTORS OF TRS-80$ EQUIPMENT, LOOK AT THE ADS IN YOUR OLD MAGAZINES, MANY OF THE ADVERTISERS ARE NO LONGER IN BUSINESS, LEVEL IV HAS BEEN A LEADER SINCE THE BEGINNING, WE STAND BEHIND OUR PRODUCTS, AND WE'LL BE HERE WHEN YOU NEED HELP.
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CIRCLE 17

27 Questions To Ask About Assemblers

Here is a list of questions that will be helpful in your selection of an assembler. If you're purchasing it from a store, get a demonstration of the program and verify that it meets your requirements, as determined by your answers to these questions.

If you are buying through the mail, send a letter to the vendor with a copy of the questions. If he hasn't got the time to answer them, he probably won't have the time to help you later if any problems arise. Find out before you buy.

While these questions represent a good starting point, they are by no means all-inclusive. You may have specific requirements that are not addressed here. Don't forget to consider these as well.

1. What hardware configuration is required? Will it work on your current system, or must additional hardware be purchased?

2. Does it come with an editor? If so, is it easy to use?

3. Does the editor have a search and replace capability?

4. Is it a screen editor or a line editor?

5. Is it a modular assembler/editor or a combined one?

6. What kind of storage media does it accommodate (tape or disk or both)?

7. Does it store source code in standard text files or in binary files?

8. Is it memory-oriented or disk-oriented?

9. Can object code be assembled directly onto disk?

10. Does the assembler produce absolute code or relocatable code?

11. Does the assembler use the microprocessor manfacturer's standard mnemonics?

12. What is the maximum number of characters permitted in a label? (The more the better.)

13. Does the assembler support global and local labels?

14. Can it assemble more than one file at a time?

15. Does it permit free-form entry of source code?

16. Does it print out the entire source and object file together in an easily readable format?

17. Does it produce a symbol reference table after an assembly?

18. Does it check syntax on entry, or must you wait until the program is assembled to locate errors?

19. Does it give English language error messages or number codes? (The former are much easier to understand.)

20. Does it flag errors in assembly so that they are easy to locate?

21. How many pseudo-ops does it have? (In general, the more, the better.)

22. How fast does it assemble source codes? (This may be a factor if you write long programs.)

23. Does the assembler support macros? If so, does it support macro libraries?

24. Is a compatible disassembler available for it?

25. Must a printer be used in order to examine the assembled code?

26. Can it be used with any kind of printer interface?

27. Is the output formatted into a listing with numbered and titled pages?

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CIRCLE 26

An Introduction To Printer Interfaces

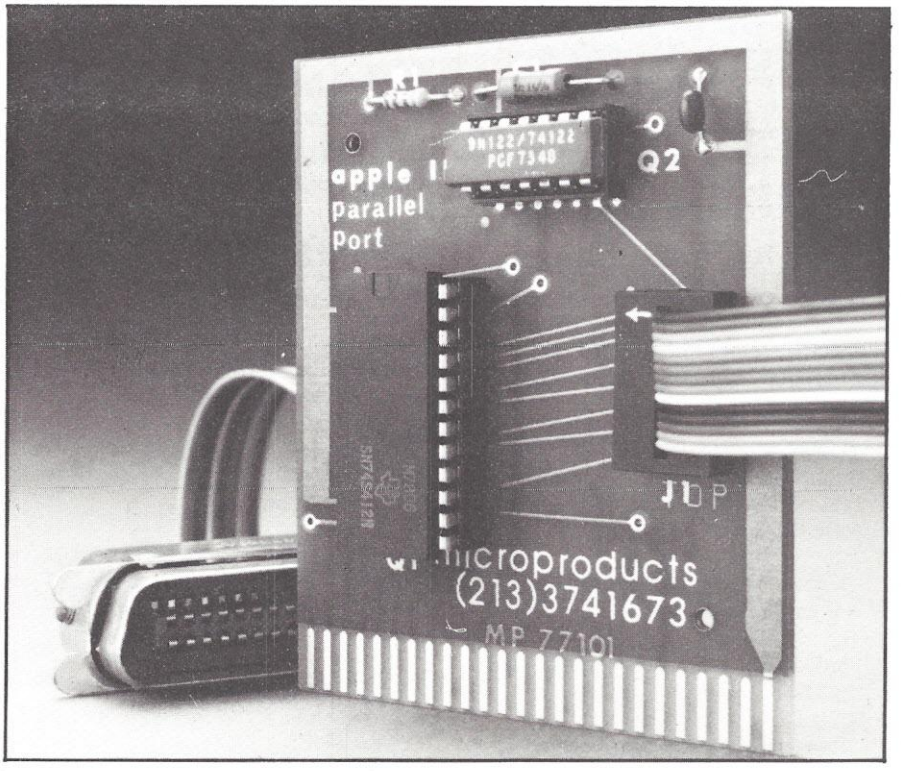
BY JULES H. GILDER

One of the most useful devices that you will probably ever hook up to a personal computer is a printer. There are many types of personal computers available, just as there are many types of printers available, and they can't all be connected to each other just like that. In order to connect them together, it is necessary to have a device that matches the computer to the printer. This device is known as a printer interface.

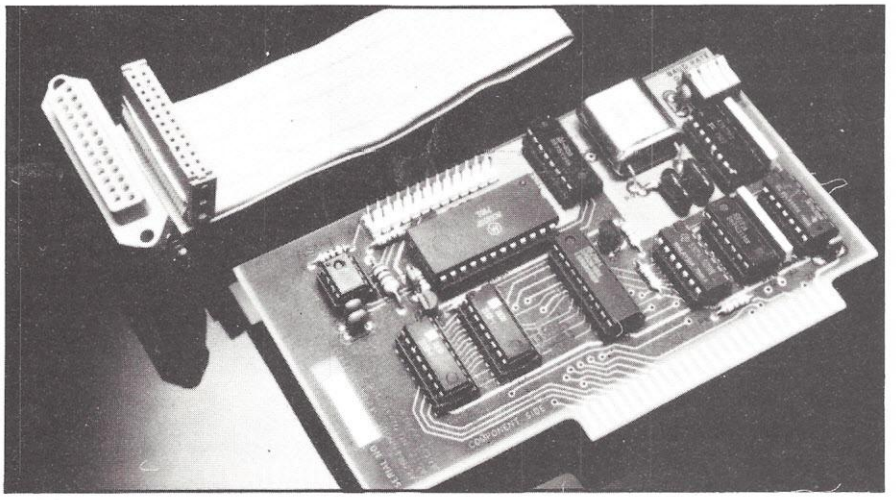
In general, a printer interface is an electronic circuit that is capable of taking electrical signals from the computer and converting them into the type of electrical signals that are needed to operate a printer. These printer interfaces can be classified into two major categories: parallel interfaces and serial interfaces. The differences between the two is in how they send the information to the printer.

Inside the computer, all of the data to be printed are represented as digital signals that are composed of 8 pulses, or bits. Each bit is moved around within the computer on a separate electrical path. So that in order to form a single character, it is necessary to collect 8 separate bits. By definition, 8 bits constitute a byte, or character.

In parallel printer interfaces each of the individual data bits that make up a single character is sent directly to the printer on its own separate electrical path. So, to send information to a printer using a parallel interface, a minimum of 8 individual wires must be connected between the printer and the computer. A little later we'll see that more than 8 are ac-



An inexpensive interface, the Parallel Output Port Card from Microproducts comes with driver software on cassette or on a separate EPROM that plugs into the Apple II mother board.

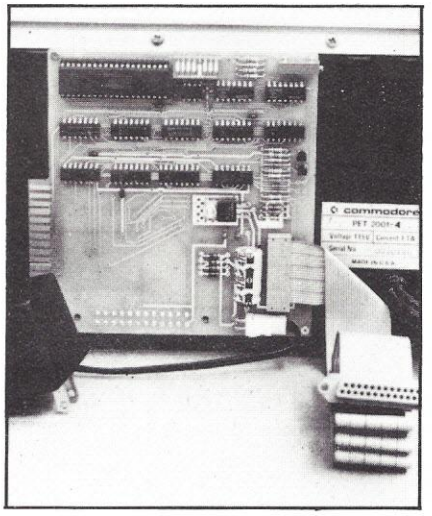


The Model 7710 is an asynchronous serial interface, for the Apple II, from California Computer Systems. DIP switches permit selection of one of 14 different baud rates.

tually used.

In serial printer interfaces, each of the 8 bits that form a single character are stored temporarily. Electronic circuitry associated with the interface takes each bit, one at a time and sends it over a pair of wires to the printer, where the 8 bits are again temporarily stored until all eight of them arrive. Once all eight bits are present, the character that was sent can be determined, and printed.

In theory therefore, a serial interface requires only two wires between the computer and the printer compared to the eight wires required for the parallel interface. In both cases, however, extra wires are added to provide for additional functions.

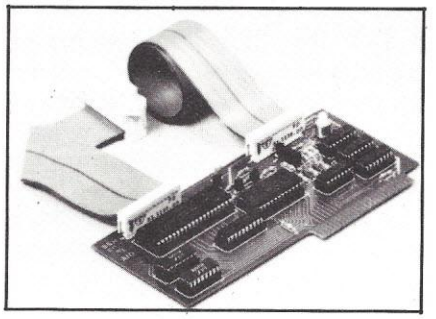


Designed as an output only interface, the TNW-1000 converts the PET's GPIB output to RS-232.

Table 1—Centronics Interface

Pin No.	Function
1	STROBE
2	DATA 1
3	DATA 2
4	DATA 3
5	DATA 4
6	DATA 5
7	DATA 6
8	DATA 7
9	DATA 8
10	ACKNOWLEDGE
11	BUSY
12	PAPER OUT
13	SELECTED
14	UNASSIGNED
15	OSCXT
16	SIGNAL GROUND
17	CHASSIS GROUND
18	+5 VOLTS
19-30	SHIELD WIRES
31	INITIALIZE
32	FAULT
33-36	UNASSIGNED

The Macrotronics parallel interfaces plug into the controller jacks of the Atari 400 and 800.



The AIO card from SSM combines a parallel and serial interface on one Apple compatible card.

Two types of parallel interfaces

Parallel printer interfaces can be broken down into two major categories those that are Centronics compatible and those that are compatible with the IEEE 488 General Purpose Instrument Bus (GPIB).

The Centronics interface is an unofficial industry standard for printers that use parallel data. But beware. Not all manufacturers implement all of the features of the interface. This may take the form of not including all of the control and auxilliary signal lines in the interface or not providing the terminating connector. The standard connector used is a 36-position Amphenol connector.

Of the 36 pins available on the connector, only 31 have defined functions in the Centronics interface. So if a printer manufacturer wishes to add additional features to his printer, he may choose to make these available by using the undefined pins on the connector, leading to incompatibility.

Handshaking is required

A personal computer can send information to a printer faster than it can be printed. If this happens, you wind up with a serious problem: part of the information will be lost and the end result could be gibberish. If the computer and the printer had some means of communicating with each other, this problem could be eliminated. The computer could send a message to the printer saying, "Here comes a character for you to print." If the computer now waited until it got a response from the printer saying, "Okay, I've got it", before sending another character, no data would be lost. This interplay back and forth between the computer and the printer, in computer jargon, is called *handshaking.*

In the Centronics interface, there are two pins on the connector through which these handshaking signals are transmitted; pins 1 and 10. As you can see from Table 1, pin 1 is labelled STROBE. This is the line that carries the message from the computer telling the printer that it has a character ready to be printed. Pin 10 is connected to the line that comes from the printer and tells the computer that it has received the character that was sent and is ready for another character. This line is labelled ACKNOWLEDGE.

The eight pins between pins 1 and 10 are used to transmit the information for each character.

The Centronics interface has several signals associated with it, the most important of these is the BUSY signal which is found on pin 11. If the printer should malfunction for some reason, say it runs out of paper, it's possible that an ACKNOWLEDGE signal will never be sent back to the computer. If this occurs, the computer can be hung up because it is waiting for a signal that is not being sent. The BUSY line of the interface prevents this.

It can be used to tell the computer that the printer is not available and that it can go ahead and do something else until the signal on the BUSY line changes again.

Getting on the IEEE bus

Another parallel interface, one that has not found wide acceptance in printer applications is the IEEE 488 GPIB interface. Originally developed by the Hewlett-Packard Company as a means of interfacing programmable instruments such as frequency synthesizers and counter/timers to each other, the bus is used by PET and CBM computers to communicate with printers.

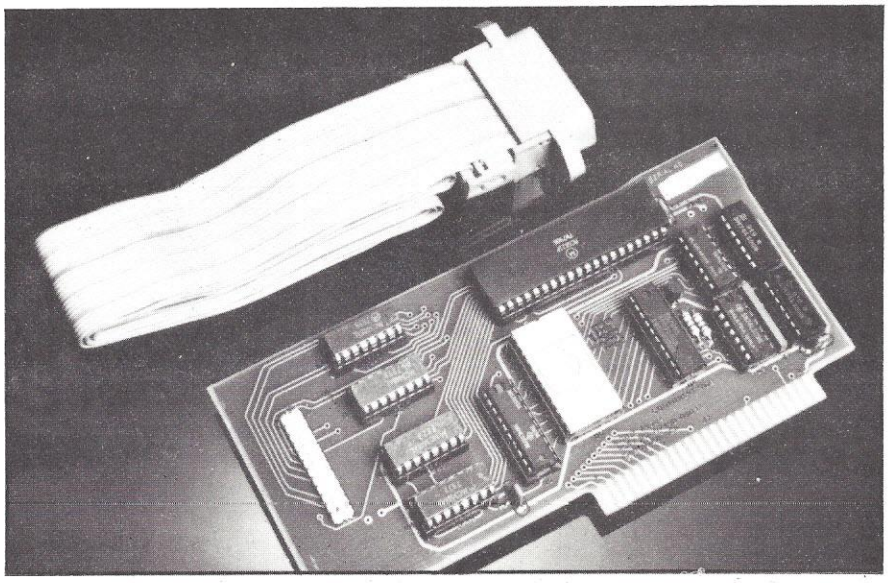
The interface consists of 24 parallel lines, 8 of which are used as grounds, 8 of which are used to send parallel data, 5 of which are bus management lines and 3 of which are handshaking lines. These last three are called Not Ready For Data (NRFD), Data Valid (DAV) and Not Data Accepted (NDAC).

An interesting thing about the GPIB interface is that it allows several devices to be connected together at one time. The interface is arranged so that it waits until the slowest device that is connected is ready before it proceeds.

The GPIB interface recognizes three different types of devices that can be connected to it:

Table 2—IEEE 488 Interface

Pin No.	Function
1	DATA 1
2	DATA 2
3	DATA 3
4	DATA 4
5	EIO
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	CHASSIS GROUND
13	DATA 5
14	DATA 6
15	DATA 7
16	DATA 8
17	REMOTE ENABLE
18-24	GROUND



The Apple can be interfaced to the IEEE 488 bus using the Model 7490 interface card from CCS. It is capable of connecting up to 15 talkers, listeners and/or controllers.

Talkers, Listeners and Controllers. Transfer of information from a personal computer to a printer involves a talker (the computer) and one or more listeners (printers). In operation the interface performs as follows. A talker waits until all listeners are ready. They signal this by releasing the NRFD line. The talker puts the data onto the data lines and then sets DAV, telling the listeners that the data is ready to be sampled. As each listener detects that the DAV line is set, it activates its NRFD line, takes the information from the data bus and releases the NDAC line. The talker can detect when the last listener releases the NDAC line and then it resets the DAV line which tells the listeners that the information on the data bus is no longer valid. New information is then placed on the bus and the process starts all over again.

Go serial with RS-232C

A popular method of connecting computers to printers is with a serial interface. The reason for this is it requires fewer wires than a parallel interface. More importantly, the length of the wires can be considerably longer because there is less chance of external noise being a problem. In addition, since most applications only use between two and four wires, it is possible to use shielded cables without incurring too much of an additional expense.

Users of serial interfaces must be very careful. While the RS-232C serial interface standard is officially recognized by the industry, most users and even many manufacturers do not truly understand it. Many RS-232C interfaces exist and they are not all compatible.

The first area of confusion is

(continued on page 71)

Table 3—RS-232C Interface

Pin No.	Function
1	Protective Ground
2	Transmitted Data
3	Received Data
4	Request To Send
5	Clear To Send
6	Data Set Ready
7	Signal Ground
8	Carrier Detector
9	Data Set Test
10	Data Set Test
11	Unassigned
12	Secondary Carrier Detector
13	Secondary Clear To Send
14	Secondary Transmitted Data
15	Transmit Clock (DCE)
16	Secondary Received Data
17	Receive Clock
18	Unassigned
19	Secondary Request To Send
20	Data Terminal Ready
21	Signal Quality Detector
22	Ring Indicator
23	Data Signal Rate Selector
24	Transmit Clock (DTE)
25	Unassigned

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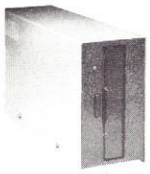

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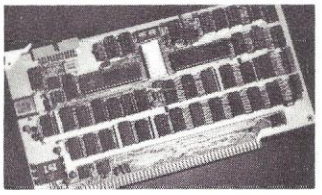

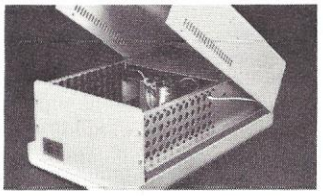

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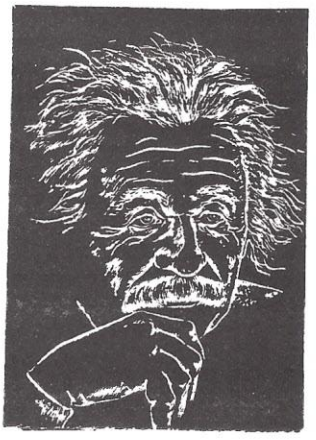
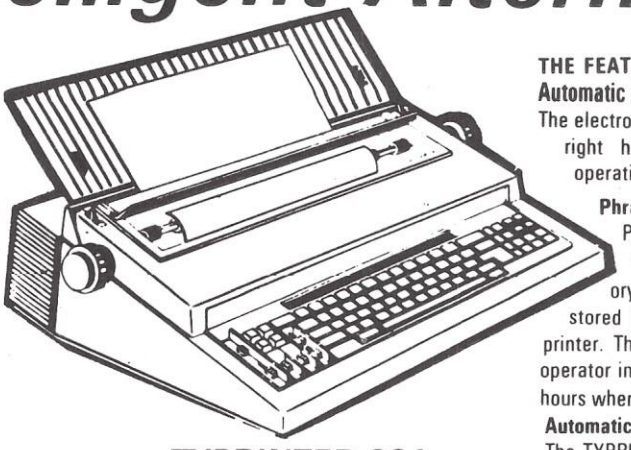




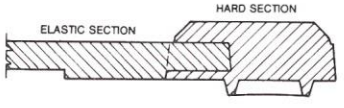
TYPRINTER 221

In the research you are doing before purchasing your computer printer, you are probably confused by the various claims, speeds, choices, shapes and prices. Well, we'd like to clear the air a bit and tell you about the most unusual computer-printer around — the TYPRINTER 221.

You see, it's unusual because it is **totally compatible** with **every** computer and word processing program . . . from the largest to the smallest. It's versatile to the point of incredibility . . . We'll discuss the broad advantages and explain the details.

THE DAISY WHEEL

The special daisy wheel supplied is of a unique design consisting of a 100 character carrying radii. Each radii is formed of two distinct types of plastic — an "elastic plastic" for the stalk of the radii, and a comparatively "hard plastic" used to form the character area. This, combined with a very narrow character profile and a special positioner on each of the 100 radii, guarantees a uniform character density. There is near perfect geometric positioning of the character with no character higher or lower than the others. And because of its unique dual material design, microvibrations have virtually been eliminated, leaving your final copy clean, clear and smudge free. The copy produced is comparable to that produced by metal daisy wheels and at a fraction of the cost.



THE KEYBOARD

The keyboard has been referred to as a triumph of human engineering - from the way the keys seem to have been custom designed to fit your fingers, to the way the special feature switches have been grouped. A flip of a switch (or under computer control of course) and the printer becomes a foreign language machine. Push a button, and like magic the printer automatically locates and lines up columns of figures, perfectly balanced between the margins. This incredibly fast, extraordinarily quiet electronic keyboard puts more programming power at you fingertips then printers costing five to ten times as much.

THE DISPLAY

The TYPRINTER 221 presents a new dimension in operator/machine communications. In the manual (typewriter) mode, the printer controls and verifies all entries before printing. The display exhibits the last 15 characters of the text, word-by-word, until the end of the line. The operator may control what will be printed before the actual printing takes place. This new found flexibility enables you to make modifications along the entire line and in both directions. This 20 character plasma display has the ability to scroll backwards as well as forwards; will give the operator a visual indication as to which print mode is currently being selected as well as the number of characters remaining before the right margin is reached. The display will also indicate to the operator:

- The number of characters available in the memory
- When the printer is in an error condition
- When a pre programmed form lay out has been selected
- When the printer is operating from the internal memory.
- What characters will be inserted into an existing text.
- When the memory for the previous line has been selected.
- A warning message that the end of the page is being approached.
- That a hyphenation decision must be made

PRINT MODE

The TYPRINTER 221 will allow you to automatically highlight individual characters, words or complete sentences. Whatever is entered from the keyboard or from the computer, even an existing text file, can be printed in one or more of the five different modes:

- traditional printing;
- underlined characters;
- true bold characters where the horizontal component of the character is increased without disturbing the vertical component;
- characters which are both bold and underlined, and;
- a feature unique among computer printers-printing in reverse — white on black, sort of reverse video on paper.

MULTILINGUAL CAPABILITY

A unique and useful feature of the TYPRINTER 221 is its capability of being able to print in several languages without changing the daisy wheel. In addition to English, every standard daisy wheel has the ability and the necessary characters to print in French, Spanish, Italian and German.

THE FEATURES

Automatic justification of the right margin

The electronics of the TYPRINTER 221 have made right hand justification a simple, automatic operation.

Phrase and format storage

Phrases, dates, addresses, data, etc. that may be stored in your computer's memory may be sent over to the printer and stored in one of the "memory bins" of the printer. This information may then be used by the operator in the manual mode. This can save you hours when trying to get a form "just right."

Automatic centering

The TYPRINTER 221 will not only center any title between the pre-set margins, but will also center over one or more columns, or over any specific point and will even align copy with the right margin independent of the left margin.

Automatic vertical lines

A command from the computer enables an automatic feature which prints vertical lines at any point on the paper.

Automatic tab sequence recall

With the TYPRINTER 221 you may store and recall the most frequently needed margin and tab sequences for applications such as daily correspondence, statistical reports, etc. This guarantees consistent high quality appearance of each document.

Paragraph indent

A computer command instantly sets a temporary margin in order to print one or more indented paragraphs with respect to the right margin.

Automatic decimal point location

No matter how many figures to either the left or right of the decimal point, the TYPRINTER 221 will automatically line up the figures with the decimal point in any position you choose. Statistical printing has never been easier.

Column layout

This feature allows you to obtain automatic and perfect distribution of spaces between columns in respect to the margins. A perfect page balance is assured without the need to carry out calculations or additional operations.

There is a wide variety of options that you can add to TYPRINTER 221.

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CIRCLE 20

It's Not All Drill and Practice

BY CAROL KLITZNER

Everyone who has paid any attention at all to the microcomputer revolution is somewhat familiar with the uses of computers for learning. Everybody must have seen at least one drill-and-practice math program at a show somewhere. Maybe most people think that's all there is to education with computers. In this article, I'd like to broaden that view by showing three of the main approaches to teaching with the computer.

Each approach to computer software is based on different assumptions about how people learn, and results in a different kind of software. As I present the three types, I'll give an example of how each approach would be used to present the same piece of information to a learner—to illustrate the ways the software would differ.

I think a perspective on different approaches will help people to evaluate software before they buy it for their own kids or for classroom use. To some extent, you should judge different styles of software by different standards. And you may look for different styles of software for different subjects. I hope this will become clear as we proceed.

Drill and practice

The major approaches to educational software that are seen today can all be traced back to the computer-based education in the 1960s. The approaches were developed for large computers with time-sharing systems, but they are now used on micros.

The first approach—drill and practice—is traceable to Patrick Suppe's Stanford University computer project, which developed, among many other things, a drill and practice arithmetic program. Drill and practice was based on a mathematical model of learning. The model said you could tell when someone had learned a skill or concept by presenting a sequence of examples and keeping track of the patterns of right answers until they matched a "criterion" that meant the skill had been learned.

For example, just to pull some numbers out of the air, you might present a series of simple multiplication problems and decide the learner had mastered this type of problem when he or she got 80 percent correct on each of two series of 20 problems. Or you might set the criterion level at 90 percent.

This kind of drill and practice approach can be seen today on micros in the Milliken math package or the Radio Shack math drill and in many other education programs.

Example 1: Drill and Practice in Computer Literacy

(The drill-and-practice program would probably not explain the commands FOR and NEXT to you at all. It would assume these had been explained elsewhere, and would present an apparently infinite series of questions like these:)

USE FOR AND NEXT TO WRITE TWO STATEMENTS THAT WILL MAKE THE COMPUTER COUNT FROM 10 TO 1.
.....

USE FOR AND NEXT TO WRITE TWO STATEMENTS THAT WILL MAKE THE COMPUTER COUNT FROM 1 TO 30.
.....

USE FOR AND NEXT TO WRITE TWO STATEMENTS THAT WILL MAKE THE COMPUTER COUNT FROM 0 TO 5.
.....

USE FOR AND NEXT TO WRITE TWO STATEMENTS THAT WILL MAKE THE COMPUTER COUNT FROM 1 TO 10.
.....

(When you could do 20 in a row correctly, you'd go on to the next kind of question.)

Drill in computer literacy

I've picked a topic in computer literacy to illustrate how the different approaches work. Computer literacy, is, of course, the ability to be fluent in a computer language like BASIC and to understand how computers are used in a variety of areas. If you were learning BASIC, one thing you would learn is how to cause the computer to "loop" around to repeat an action a number of times, and count the number of repetitions. Example 1 shows how the BASIC words FOR and NEXT might be presented to you via drill and practice.

You can see that you would certainly learn to write this kind of statement perfectly. Then you'd go on to practice some other aspect of loops, and finally to put it all together.

Use programmed instruction

The tutorial approach was also developed in the 1960s. The basis for this approach was B. F. Skinner's programmed instruction. You probably have encountered at least one programmed-instruction book somewhere along the line. It presents information in tiny units, asks a question on that tiny piece of information, and lets you find

out if you answered correctly before you go on to the next tiny bit of information. P-I is supposed to gradually shape your behavior until you reach a level where you have all the pieces of the skill you're learning.

Tutorials on the computer followed this model, but presented the information on the teletype or screen.

Programmed instruction and tutorials have come a long way. Most notably, they are not as tedious and repetitious as they once were. But you can still recognize the many tutorial software packages for micros because they present information in logical sequences and pause frequently to ask a question based on the information.

Tutorials in computer literacy

In our computer literacy course, the commands FOR and NEXT would be presented as they are in Example 2.

Again, you can see that this would probably work. You would learn how to use loops, and, depending on how well the sequence was written, you would understand what you were doing very well.

The computer as a tool

As a reaction against the first two approaches to software, which were criticized as "page turners" that didn't go beyond automating a textbook, the problem-solving approach developed.

In an early example, BASIC was taught to high school students in the late 60s to help them solve math problems. They learned both programming and math. A second example, the Logo project, was started by Seymour Papert and Walter Feurzeig at M.I.T. Based on the theories of Jean Piaget about how children learn logic, the project teaches very young children to solve problems of their choice using the Logo language. For example, the children can program a computer-driven "turtle" to draw geometric figures.

I think of this approach as using the computer as a tool because what all the projects have in common is that the student is given a chance to explore a domain of knowledge by controlling the computer and using it as a tool.

An example of this approach on a micro is a program developed by Advanced Learning Technology under an Apple Education Foundation grant. Young children learn the concepts above, below, left and right using free exploration activities. In one phase of the program, as the child touches the above a midpoint on the keyboard, graphics appear above a line on the screen, and a voice says "above." The opposite happens when keys are touched below the midpoint.

Example 2: Tutorial in Computer Literacy

(The computer would present the commands FOR and NEXT and describe their use. Then it would ask:)

WHAT IS THE PURPOSE OF THE FOR AND NEXT COMMANDS?

A. TO REPEAT A SEQUENCE AND COUNT THE REPETITIONS
B. TO LOOP FOREVER
C. TO TELL YOU WHAT TO DO NEXT
D. TO PRINT NUMBERS ON THE SCREEN
.....

(The computer would tell you how this type of loop compares to other loops you've studied and ask:)

FOR/NEXT LOOPS ARE SIMILAR TO _____ LOOPS.
.....

(The computer would show you an example of a loop and explain how the loop counts from 1 to 5.)

```
FOR X = 1 TO 5
NEXT X
```

NOW WRITE THE FIRST LINE OF A LOOP THAT COUNTS FROM 1 TO 10.
.....

THE VARIABLE X ACTS AS A COUNTER FOR THE LOOP. (TRUE OR FALSE)
.....

(The program would continue in this way through all the concepts of the loop.)

Example 3: The Computer as a Tool in Computer Literacy

(The program would give you this example over and over again.)

```
10 FOR X = 1 TO 10
20 PRINT X
30 NEXT X
```

RUN THIS TO SEE WHAT HAPPENS. THEN CHANGE ANYTHING IN THE PROGRAM AND RUN IT AGAIN TO SEE WHAT IS DIFFERENT.

In our computer literacy course, the computer would present the program in Example 3. You wouldn't understand the program when you first saw it, but you could run it and see what hap-

pened, then change anything about it and run it again as often as you liked. Gradually you would begin to form hypotheses about what each part of each statement did. The computer might give you feedback to every change you made, telling you after the run what was different that time.

It might take you a long time to form and test hypotheses, but eventually you would understand these commands thoroughly.

Picking software

In picking educational software for your children or for a class, you are faced with the task of making a quick judgment on whether a particular program is suitable and useful. One of the first things you might do is note what approach the software uses and decide whether that is the approach you prefer for that particular subject.

Although all the approaches I described can work very well, some topics lend themselves to one approach or another. I think the drill and practice and computer-as-a-tool approaches were not as effective as the tutorial in our computer literacy example. On the other hand, drill and practice is very useful for practice of computation skills. And the computer as a tool is a useful approach for exploring a set of related laws in a simulation of a science experiment.

Once you've decided that the approach is appropriate for the subject and that the instructions are clear, you may want to examine the software more carefully to see how well it meets the standards for that approach.

For drill and practice software, you would look to see that problems are presented in logical sequence. For example, problems in division shouldn't be given before necessary multiplication skills are learned. You'd look for reasonable criteria levels that make sure you get enough drill and also for feedback that tells you when to proceed to the next set of problems.

In tutorials, logical sequencing may be even more important than in drill. You'd check to see that each unit of information follows logically from the previous material with no gaps where information is left out. You'd see what kind of questions are asked and be sure that at least some were required understanding, not just rote memory. There should be branching to simpler material when needed and clear reinforcement telling you whether or not you are correct.

When the computer is used as a tool, the program will often be a simulation. Simulations can be used in tutorials to illustrate points and even in drill and practice, as in training someone how to operate a machine. Since the program should allow you to control the computer, you should see whether the program can handle all the kinds of entries you might make. What happens if you type in a number that's too high or too low? Or type in a letter where you should type in a number. Does the computer give you guidance or does it just tell you that you made an illegal entry or even stop running? You should also try to judge whether the process is being simulated in a reasonable way. Also check to see whether the body of knowledge you're exploring is complete and correct.

Consider variety

All approaches to educational software can be useful and valid. Whether you're picking software or writing your own, you should consider a variety of approaches for different topics. □

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CIRCLE 35

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CIRCLE 36

Flex-Plot

BY JERRY W. FROELICH

I named the program Flex-Plot and wrote it to fill the need of plotting several dependent variables against one independent variable on the same graph. Flex-Plot can be used on various sized output devices so the number of rows and columns can be adjusted. Other options will be covered later.

Flex-Plot is a subroutine with two smaller subroutines embedded in the main one. The first routine scales the axis as a function of the maximum and minimum values of the axis. The other routine is a space saving routine which prints the top and bottom labels.

To use the routine, there are a number of variables that must be defined in the main program.

- NO$ = A string variable containing the title of plot.
- A$ = An array containing the independent and dependent variable. The array is structured so that the first m-locations contain the independent variable (X). The next "N" sets the "M" locations containing the dependent variables. There is a maximum of 9 dependent variables and there must always be "M" variables for each dependent variable.
- N = Number of observations (sets)
- M = Number of variables in each observation.
- I0 = Number of columns on the output device, must be divisible by 10.
- LO = Number of lines per page.
- X1 = Xmax, X2 = Xmin, Y1 = Ymax, Y2 = Ymin. These variables define the limits of the X and Y axes. If auto-scale is desired set X1 = X2 and/or Y1 = Y2.

This routine was initially written in Fortran and translated into Basic. The listing is from a Wang Computer and except for the PRINT USING statements and line 8715 which contains a special Wang function that converts an integer to an ASCII character for printing, the routine is standard Basic. Line 8715 can easily be converted to your Basic (i.e. for the Pet it would be: 8715 IO$(J1) = STR$(J-1)).

Because of the underlying flexibility of this routine and there not being a requirement that the numbers in "A" be in ascending order, this routine is slow when there are a number of points to plot. □

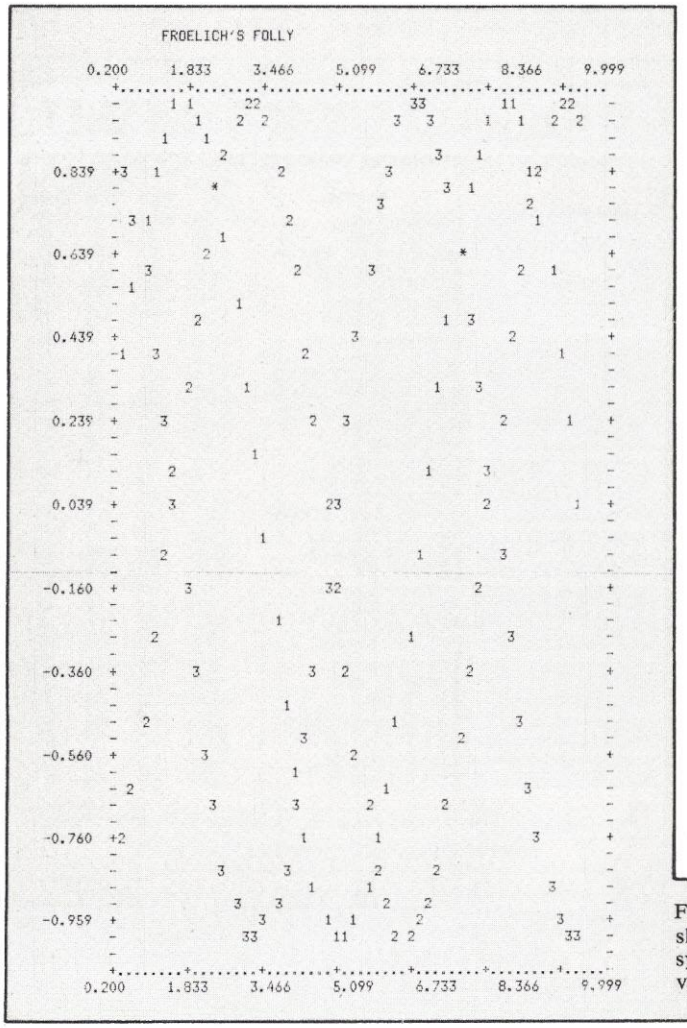

Figure 1. This is a plot of three, out-of-phase sine waves shown printed on the same graph. Where data points overlap, a "*" symbol is printed. (Note: It helps to squint a bit when you're viewing these types of graphs for the first time.)

For BASICs without PRINTUSING

Not all versions of BASIC have the PRINTUSING statement, as this version of Wang BASIC does. To overcome this incompatibility, all you have to do is round off any number that is printed with the PRINTUSING in this program, to three decimal places. This can be done by jumping to the following subroutine to do the rounding and then changing the PRINTUSING statement to a PRINT statement. 'N' is the number that would normally have been printed with the PRINTUSING statement.

```
30000 REM THIS IS THE ROUNDOFF ROUTINE
30010 N = INT (1000*N + .5) /1000
30020 RETURN
```

So a program that originally had a PRINTUSING statement would replace it with a GOSUB 30000:PRINT N, where N is the number to be printed.

Program Listing

```
9000 REM TEST PROGRAM FOR FPLOT
9005 DIM A(200)
9010 N0$="FROELICH'S FOLLY"
9015 N=3
9020 X1=X2:Y1=Y2
9025 M=50
9030 I0=80
9035 B=0.0
9040 L0=25
9045 FOR I=1TO 50
9050 A(I)=I/5
9051 A(I+100)=SIN((I+25)/5)
9052 A(I+150)=SIN((I+40)/5)
9055 A(I+50)=SIN(I/5)
9060 NEXT I
9065 SELECT PRINT 215(132)
9070 GOSUB 8095
9075 SELECT PRINT 005(64)
9080 PRINT "THAT IS ALL FOLKS"
9085 END
9090 REM ************************************************
9095 REM FLEX-PLOT
9100 REM THIS PLOT SUBROUTINE WILL ALLOW CHANGING OF MARGINS
9105 REM FOR DIFFERENT SIZE OUTPUT DEVICES AND IT WILL ALLOW
9110 REM YOU TO PLOT UP TO 1 DEPENDENT AND 9 INDEPENDENT
9115 REM SETS OF DATA POINTS.
9120 REM
9125 REM N0$= TITLE OF CURVE
9130 REM A=ARRAY WHOSE 1ST N POSITIONS CONTAIN THE INDEPENDENT
9135 REM   VARIABLE AND WHOSE NEXT M SETS OF N POSITIONS
9140 REM   CONTAIN THE DEPENDENT VARIABLES.
9145 REM
9150 REM N= # OF OBSERVATIONS
9155 REM M= # OF VARIABLES IN EACH OBSERVATION
9160 REM X1=XMAX,X2=XMIN,Y1=YMAX,Y2=YMIN FOR THE
9165 REM   INDEPENDENT AND DEPENDENT VARIABLES. IF XLAX=XLIN
9170 REM   AND/OR YLAX=YLIN THEN THE ROUTINE WILL CREATE ITS
9175 REM   OWN SCALE VALUES.
9180 REM
9185 REM I0=# OF COLUMNS IN THE OUTPUT DEVICE/MUST BE DIVISIBLE
9190 REM      BY 10.
9195 REM L0= # OF LINES PER PAGE.
9200 REM ************************************************
8205 DIM I0$(133),X8(14)
8210 I2=I0-20
8215 I3=I2/10
8220 L9=L0/5:IF L9*5=L0 THEN 8235
8225 L9=(L9+1)*5
8230 GOTO 8245
8235 L9=L9*5
8240 REM
8245 REM GOTO TOP OF FORM AND PRINT TITLE
8250 REM
8255 PRINT HEX(0C): PRINT TAB(I3*4);N0$:PRINT
8260 K=4
8265 REM
8270 REM CALC EXTREMES OF X
8275 REM
8280 IF X1<>X2 THEN 8330
8285 X3=A(1):X4=X3
8290 FOR J=1 TO M
8295 IF (A(J)-X3)<0 THEN 8310
8300 IF (A(J)-X4)<=0 THEN 8320
8305 IF (A(J)-X4)>0 THEN 8315
8310 X3=A(J):GOTO 8320
8315 X4=A(J)
8320 NEXT J
8325 GOTO 8335
8330 X4=X1:X3=X2
8335 X9=(X4-X3)/I2
8340 IF (X1-X2)<>0 THEN 8365
8345 Z1=X3:Z2=X4:X=X9
8350 GOTO 8365
8355 GOSUB 8875
8360 X9=X
8365 IF (Y1-Y2)<>0 THEN 8450
8370 REM
8375 REM CALC EXTREMES OF Y
8380 REM
8385 L=M+1
8390 Y3,Y4=A(L)
8395 L1=M+(M*N)-1
8400 FOR J=L TO L1
8405 IF (A(J)-Y3)<0 THEN 8425
8410 IF (A(J)-Y4)<=0 THEN 8440
8415 IF (A(J)-Y4)>0 THEN 8435
8420 X9=X
8425 Y3=A(J)
8430 GOTO 8440
8435 Y4=A(J)
8440 NEXT J
8445 GOTO 8455
8450 Y4=Y1:Y3=Y2
8455 Y9=(Y4-Y3)/L9
8460 Z1=Y3:Z2=Y4:X=Y9
8465 GOSUB 8875
8470 X8(1)=X3
8475 REM
8480 REM STORE X VALUES FOR AXIS
8485 REM
8490 FOR J=1TO13
8495 X8(J+1)=X8(J)+X9*10.
8500 IF (ABS(X8(J+1)-.5*X9))>0 THEN 8510
8505 X8(J+1)=0.0
8510 NEXT J
8515 PRINT TAB(10);:FOR I=1TO I3+1:PRINTUSING 8520,X8(I);:NEXTI:PRINT
8520 %    ###.###
8525 GOSUB 8545:GOTO 8600
8530 REM
8535 REM TOP AND BOTTOM LINE OF PLOT ROUTINE
8540 REM
8545 FOR I= 1 TO I2
8550 I0$(I)="."
8555 NEXT I
8560 FOR I= 1 TO I2 STEP 9
8565 I0$(I)="+"
8570 NEXT I
8575 REM
8580 REM PRINT LINE
8585 REM
8590 PRINT TAB(18);:FOR I=1 TO I2+1:PRINT I0$(I);:NEXT I:PRINT
8595 RETURN
8600 Y8=Y4:K=0
8605 REM
8610 REM START PRINTING AT MAXY
8615 REM
8620 FOR I=1 TO 12:I0$(I)=" ":NEXT I:REM  FILL WITH BLANKS
8625 FOR J=2 TO N+1
8630 L2=(J-1)*M
8635 FOR L=1 TO M
8640 L1=L2+L
8645 J1=ABS(Y8-A(L1))-.5*Y9
8650 IF J1<0 THEN 8670
8655 IF J1>0 THEN 8720
8660 IF (ABS(Y8-A(L1))-.5*Y9)>0 THEN 8720
8665 IF (Y8-A(L1))<0 THEN 8720
8670 J1=(A(L)-X3)/X9+1.5
8675 IF (J1-1)<0 THEN 8720
8680 IF (J1-I2+1)>0 THEN 8720
8685 IF I0$(J1)=" " THEN 8715
8690 I0$(J1)="*"
8695 GOTO 8720
8700 REM
8705 REM CONVERT IS A ROUTINE TO CHANGE FROM REAL TO ASCII
8710 REM
8715 CONVERT (J-1) TO I0$(J1),(#)
8720 NEXT L
8725 NEXT J
8730 K=K+1
8735 REM
8740 REM PRINT VALUE ON VERTICAL AXIS
8745 REM
8750 IF K=5 THEN 8770
8755 I0$(1)="-":I0$(I2+1)="-"
8760 PRINT TAB(18);:FORI=1 TO I2+1:PRINT I0$(I);:NEXT I:PRINT
8765 GOTO 8810
8770 IF (ABS(Y9)-.5*Y9)>0 THEN 8785
8775 F=0.0
8780 GOTO 8790
8785 F=Y8
8790 I0$(I2+1)="+":I0$(1)="+"
8795 PRINTUSING 8800,F;:FOR I =1TO I2+1:PRINT I0$(I);:NEXT I:PRINT
8800 %         -###.###
8805 K=0
8810 IF (Y8-Y3)<=0 THEN 8840
8815 Y8=Y8-Y9
8820 GOTO 8620
8825 REM
8830 REM THAT WAS THE END OF THE PRINT LOOP
8835 REM
8840 GOSUB 8545
8845 PRINT TAB(10);:FORI=1TO 13+1:PRINTUSING 8520,X8(I);:NEXT I:PRINT
8850 PRINT:PRINT
8855 RETURN
8860 REM ******************************************
8865 REM SCALE SUBROUTINE
8870 REM
8875 F=LOG(X)/LOG(10.0)
8880 IF F>=0 THEN 8895
8885 J1=F-1
8890 GOTO 8900
8895 J1=F
8900 F=10.↑J1
8905 IF (F-X)>=0 THEN 8935
8910 F=F+1
8915 IF (F-X)>=0 THEN 8935
8920 F=1.25*F:IF (F-X)>=0 THEN 8935
8925 F=F+F: IF (F-X)>=0 THEN 8935
8930 F=F+F: GOTO 8905
8935 X=F
8940 J1=Z2/X
8945 F=J1*X
8950 IF (F-X)>=0 THEN 8960
8955 J1=J1+1: GOTO 8945
8960 Z2=F
8965 J1=Z1/X
8970 F=J1*X
8975 IF (F-Z1)<=0 THEN 8990
8980 J1=J1-1
8985 GOTO 8965
8990 Z1=F
8995 RETURN
9000 END
```

How To Boot Binary Programs

BY JULES H. GILDER

The Apple II disk operating system is set up so that when a diskette is "booted" (activated), one of the programs on the diskette will automatically be run. This program is referred to in Apple literature as the HELLO program, and in fact it is often called HELLO.

One of the limitations of the Apple disk operating system, is that this HELLO program must be a BASIC program, written either in Applesoft or Integer BASIC. This can cause problems if the program to be run is a machine language (binary) program. If you try to use a machine language program as your HELLO program, the Apple will generate a FILE TYPE MISMATCH error.

Solving the problem

Some programmers have overcome this problem by writing a one line HELLO program in BASIC, which simply BRUNs the desired machine language program. BRUN is the command used to run a machine language program. This approach is fine, unless you want your disk to work on all versions of the Apple computer. If your HELLO program is written in Integer BASIC, and you try to run it on an Apple II Plus, which has only Applesoft available, you will get a LANGUAGE NOT AVAILABLE error. The same will happen if an Applesoft HELLO program is used on a computer with only Integer BASIC.

It is possible to solve this problem by having two programs in addition to the desired machine language program on your disk. The first program would be the HELLO program and should be written in Applesoft. The second program should be the Integer BASIC equivalent of the HELLO program. When this program is saved onto the disk, it should be saved under the name of APPLESOFT. Once this is done, the disk will "boot" on either a regular Apple II or an Apple II Plus.

In an Apple II Plus, when the disk is booted up, it sees that the HELLO program is an Applesoft program, loads it and runs it. So far, no problems. If the same disk is used in a computer that has only Integer BASIC available, something else happens. As the disk is booting, the computer sees that the HELLO program is an Applesoft program, and checks to see if Applesoft is available on a firmware card in slot zero. If it is, it activates the Applesoft ROMs and runs the HELLO program, just as in the case of the Apple II Plus. But, if Applesoft is not available in ROM, the computer then takes a look at the programs stored on the diskette to see if any programs on the disk are called APPLESOFT. If a program called APPLESOFT is present (and it should look like an Integer program to the computer) then it is loaded and run. If the program loaded really *is* APPLESOFT, the computer will then continue and run the HELLO program. However, if the program called APPLESOFT is not really the Applesoft language, then the computer will do whatever it is instructed to by the program; in this case it will BRUN the desired machine language program.

Making it easier

If all of this seems complicated, that's because it is. But you don't have to be concerned, because the short program presented here will make everything a lot simpler, and it eliminates the need for the two BASIC programs (Integer and Applesoft). It does this by modifying the DOS (disk operating system) on the diskette so that when it finds the HELLO program, it will BRUN the program insted of RUN it.

Ordinarily, modifying the DOS on a diskette is a complicated task, not generally attempted by, (or recommended for) any but the most advanced programmers. The reason is simple—it's too easy to make an error and ruin the diskette completely.

In addition, to make the required modification, it is generally necessary to have a special disk utility program that is capable of reading, modifying and writing individual sectors of a diskette. Such programs generally cost about $30. The program accompanying this article makes it possible for even the rank beginner to modify the DOS on any diskette and convert it to a "BRUN boot" diskette. It also eliminates the need for the expensive disk utility program.

Just change one byte

To modify the DOS to allow it to BRUN the HELLO program, it is only necessary to change one byte in the DOS. This byte is located on track 1, sector 0. It is byte 66 and it must be changed from a 6 to a 52.

Normally, reading and writing individual sectors on a diskette can be quite difficult. However, the Apple disk operating system has a nice set of machine language routines that makes this simple. They are called RWTS (for read, write, track and sector). By using these routines, we can have the Apple do all the work, and we only have to change one byte in memory to specify which action we want these routines to perform.

To use RWTS, it is necessary to set up a small machine language program like the one below:

```
0800-  A9 08     LDA  #$08
0802-  A0 0A     LDY  #$0A
0804-  20 D9 03  JSR  $03D9
0807-  60        RTS
```

What this short program does is to tell the DOS where to look to get the information it needs to perform a disk operation. This is done by loading the address of the desired information (which is often referred to as the Input/Output Block, or IOB) into two specific locations in memory—the accumulator and the "Y" register. After that has been done, the program jumps to the RWTS routines and performs the required operation.

Explanation of the program

The first line of the program, line 10, protects the low end of memory so that the machine language program and Input/Output Block are not accidentally destroyed by the Integer BASIC program. Lines 20 through 80 enter the machine language program and the IOB information. Next, line 90 insures that the computer is not in one of the graphics modes, while line 100 clears the screen and places the cursor in the upper lefthand corner.

Lines 120 through 220 print out the program name, author, and copyright notice, while line 230 write-protects this information on the screen and prevents it from scrolling off. Line 260 defines the location in memory of the disk Input/Output Block, while line 290 checks to see if any key on the keyboard has been pressed yet.

In line 300, a test is made to see if the ESCape key has been pressed. If it has, the program jumps to line 510 where the keyboard is reset, the anti-scroll protection is removed (line 520), and the program is stopped. If the ESCape key was not pressed, another test is made. This one is to see if the RETURN key was pressed. If it wasn't, the program returns to line 290 and checks the keyboard again. If it was, then the program proceeds to read in track 1, sector 0. It does this by jumping to the machine language program that starts at location 2048 in memory (line 330).

After the desired sector is read in, the program checks to see if byte 66 of this sector is 6, as it should be for a disk with conventional DOS. If it's not, the program branches to line 390 to perform further tests. If it is, the 6 is changed to a 52 (line 350), the operation to be performed by the disk is changed from a read to a write (line 360), and the modified sector is written onto the diskette (line 370). The program then jumps to line 470 where a FINISHED message is printed. In line 490, the operation to be performed by the disk is changed from a write to a read. Control is then passed to line 270 where the user has the opportunity to update another disk, or terminate the program.

If byte 66 of track 1, sector 0 is not a 6, line 390 checks to see if it is equal to 52. If it is, a message stating that the diskette has already been updated is printed, and the program is set up for the next diskette. If byte 66 is not equal to 6 or 52, then the DOS on the diskette is not a conventional DOS (this is common on copy-protected disks), the update is not performed and a message to that effect is printed. The program is then set up to accept the next diskette.

As you can see, modifying the DOS on a diskette and using machine language, do not have to be frightening experiences. □

Program Listing

```
 10 POKE 74,36: POKE 75,8: POKE 204,36: POKE 205,8
 20 POKE 2048,169: POKE 2049,8: POKE 2050,160: POKE 2051,10
 30 POKE 2052,32: POKE 2053,217: POKE 2054,3: POKE 2055,96
 40 POKE 2056,0: POKE 2057,0: POKE 2058,1: POKE 2059,96
 50 POKE 2060,1: POKE 2061,0: POKE 2062,1: POKE 2063,0
 60 POKE 2064,251: POKE 2065,183: POKE 2066,0: POKE 2067,9
 70 POKE 2068,0: POKE 2069,0: POKE 2070,1: POKE 2071,73
 80 POKE 2072,98: POKE 2073,96: POKE 2074,1
 90 TEXT
100 CALL -936
110 VTAB 3
120 TAB 12
130 PRINT "BRUN BOOT UPDATE"
140 PRINT
150 PRINT
160 TAB 11
170 PRINT "BY JULES H. GILDER"
180 PRINT
190 TAB 11
200 PRINT "COPYRIGHT (C) 1981"
210 TAB 10
220 PRINT "ALL RIGHTS  RESERVED"
230 POKE 34,9
240 POKE 74,36
250 POKE 75,8
260 IOB=2057
270 PRINT : PRINT "HIT 'RETURN' TO UPDATE OR"
280 PRINT "    'ESC' TO QUIT"
290 K= PEEK (-16384)
300 IF K=155 THEN 510
310 IF K#141 THEN 290
320 POKE -16368,0
330 CALL 2048
340 IF PEEK (2370)#6 THEN 390
350 POKE 2370,52
360 POKE IOB+13,2
370 CALL 2048
380 GOTO 470
390 IF PEEK (2370)#52 THEN 430
400 PRINT
410 PRINT "THIS DISK HAS ALREADY BEEN UPDATED."
420 GOTO 490
430 PRINT
440 PRINT "THIS IS NOT A STANDARD DOS DISK."
450 PRINT "UPDATE HAS BEEN TERMINATED."
460 GOTO 490
470 PRINT
480 PRINT "FINISHED."
490 POKE IOB+13,1
500 GOTO 270
510 POKE -16368,0
520 POKE 34,0
530 END
```

Assessing Project Risk

BY ERIN CLAUDE LOONEY, LAURETTE S. LOONEY AND CARL G. LOONEY

Project Risk is the probability of failure to meet some criterion; with criterion usually being either time or cost. This TRS-80 Level II program is designed to use one or the other of these criteria as you specify. Essentially, the program is designed to convert the experience and intuition of a manager into quantities from which probability density functions can be constructed for the tasks in a project. Monte Carlo runs are used to convert the random numbers drawn from these probability distributions into a risk function for the entire project.

A project consists of a series of stages with each stage having one or more tasks which are done simultaneously. Figure 1 shows a simple example of a project network graph which we will use as a tool for explaining the use of this program. In this article we will assume that you have selected time as your criterion. We will, however, point out the differences for using cost where such differences exist.

Setting Up the Network Values

The first step in the assessment of risk for a project is to construct a network graph as shown in Figure 1. All tasks which are to be done simultaneously are put into the same stage. The setting up of a network graph requires that a manager think through the project and know what he needs and wants. The network is itself a useful tool for the project manager.

Not all tasks in one stage of a project connect to all tasks of the succeeding stage. Connections are made from a task in one stage to a task in the next stage whenever the output of the first task is needed in the task in the later stage. In the example of Figure 1, you see that Task 2,3 (task number 3 of stage number 2) does not require Task 1,1 to be completed before Task 2,3 can begin. Task 3,2, however, uses the results of both Task 2,3 and Task 2,1. Since Task 2,1 depends upon Task 1,1, Task 3,2 can not begin until Task 2,1 is completed. The assumption, implicit in the program, that Stage 2 can not begin until all tasks in Stage 1 are completed adds no extra constraint on the network. When cost is used instead of time as the failure criterion, such an assumption is not valid and is not used in the program since the costs of all tasks are summed for project cost.

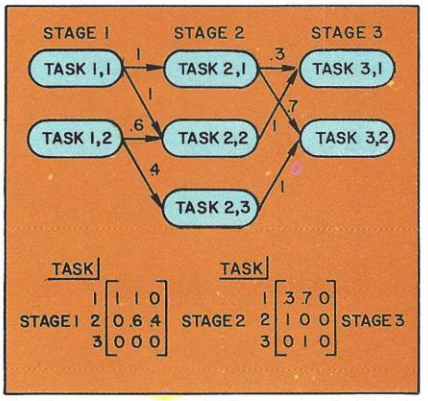

Figure 1—Network graphs make it easy to understand a project.

If Task I,K (task number K in the Ith stage) connects to a task in the next stage (stage I+1), it is not necessarily true that this path is always taken. Each connecting arrow has a probability associated with it that the path will be used. For example, in Figure 1, Task 1,2 connects to Task 2,2 with the probability of .6 and connects to Task 2.3 with the probability of .4. Thus, Task 1.2 will lead to Task 2,2 60 percent of the time and to Task 2,3 the remaining 40 percent. Task 1,1 always leads to both Task 2,1 and Task 2,2, as indicated by the probability of 1 which indicates certainty. For a task that never leads to a particular task in the next stage there is no connecting arrow but we could put in an arrow with an accompanying probability of zero.

The information on the connecting arrows between tasks is kept in simple bookkeeping arrays—matrices. Figure 1 has two matrices. The first matrix shows the connections and probabilities from Stage 1 to Stage 2. For example, in row 2, column 3 the entry .4 designates that Task 1,2 connects to Task 2,3 40 percent of the time. Zeroes indicate no arrows. All matrices are the same size, NT x NT, where NT is the maximum number of tasks in each stage.

The probabilities in these transition matrices are derived by the project manager who "guestimates" and then adjusts back and forth until he or she is satisfied. Consultation with personnel who have experience in certain tasks is helpful, but in the end a manager must assimilate all information and decide on the numbers. The manager can also experiment with different numbers to help assess the project.

At this point, you must have a network graph of the project with the transition matrices completed. The transition to the first stage is an identity matrix that the program automatically computes.

Program algorithms need another crucial set of estimates to assess project risk and you are asked to input the following estimates for I=1 to the number of stages (NS) and for K=1 to the maximum number of tasks per stage (NT). Remember, we are using time but

cost is similar:

TO(I,K)—most optimistic time required for completion of the Kth task of the Ith stage if work on the task proceeds exceptionally well to the tune of approximately a 1-in-100 long shot;

TL(I,K)—most likely time required for completion of Task I,K;

TP(I,K)—most pessimistic time required for completion of Task I,K if everything goes wrong as could be expected about one out of a hundred times.

For stages with fewer than NT tasks, you must input time values for each task and then input zeroes as the computer, which is programmed to expect a total of NT tasks per stage, continues to request time values for all NT tasks. This is simply an accommodation to the program.

Running the Program

When you have a network graph for the project, the transition matrices for going from one stage to another, and a list of estimates of the most optimistic, likely and pessimistic times for completion of the various tasks, you are ready to run the program. The computer will request the following:

1. Input NS=number of stages;
2. Input NT=maximum number of tasks per stage;
3. Input NR=number of Monte Carlo runs wanted (25 to 100 should be used with more being better but you may run out of memory);
4. Input NG=number of groups (intervals) wanted in project histogram (9-14);
5. Input 1 for "time" or 2 for "cost" criterion;
6. Input values TO(I,K), TL(I,K) and TP(I,K) for I=1 to NS and K=1 to NT;
7. Input transition matrix values A(I,K,L) for I=2 to NS, K=1 to NT, and L=1 to NT (actually, the rows are requested alternating with the values for TO, TL and TP above);

The resulting outputs will be:

1. Output mean value (TB) for entire project;

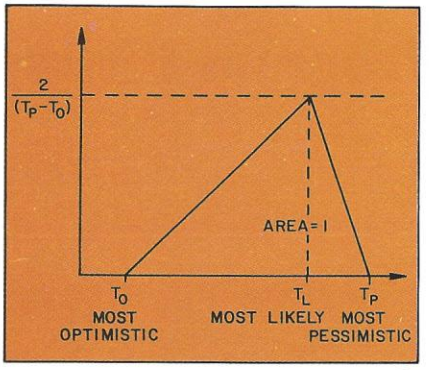

Figure 2—The program constructs a probability density function for each task.

2. Output standard deviation (ST) for project;
3. Output times and the probabilities of exceeding those times for hard copy graph of total project risk profile to be plotted from (by hand by the user);
4. A plot of a bar-type risk profile on the video screen with values for upper and lower limits.

The bar graph on the video monitor is for the information of the user but should not be used in analysis, assessment, or management of project risk. Reasonably accurate values cannot be taken from the screen. This graph is only a momentary construction and is gone forever once Enter is keyed.

Program algorithms construct a probability density function for each task from the estimates for the most optimistic, likely and pessimistic values. Figure 2 shows an example of this function. For each Monte Carlo run, a random number T(I,J,K) is chosen from the probability distribution for Task I,K (on the Jth run). Since some of the tasks are not used in certain runs depending on the probabilities of the connecting arrows to them, some complication arises.

Let p (whose value is neither 0 nor 1) be the probability for an arrow which points into Task I,K. A random number R1 is drawn by means of the Levell II BASICfunction RND(0). A test is then made: R<p leaves T(I,J,K) at its currently stored time value taken from the probability distribution for Task I,K; but R1 >=p causes no decision to be made. In a case where p=1, T(I,J,K) is left alone, but if p=0 for all arrows into Task I,K, the T(I,J,K) is set to zero.

If in the test described above, R1>=p for every arrow coming into Task I,K, then T(I,J,K) is set to zero for the Jth run. For example (in Figure 1) Task 2,3 may not be used if R1=RND(0) is drawn and R1<.6. In this case, Task 2,2 will use the outputs of Task 1,2. You can see that Task 3,2 may not be used on some runs when certain random numbers are drawn.

Next, the program finds, the maximum time value for the tasks used at each stage for each Monte Carlo run. (For cost, the sum of the costs of all the tasks used at each stage are taken.) The total time (cost) for that particular run is then determined. This number is one output value for the total project. After NR runs, you have an output sample for the project.

A histogram, as shown in Figure 3, is computed from the output sample. A histogram is a bar chart where the height of each bar represents the number of output values of the sample which fall into that interval on the horizontal axis (bar width). A frequency polygon is then constructed as shown in Figure 3.

The values of the risk profile function (Figure 4) are obtained by taking 1 minus the frequency polygon values. Figure 4 shows the way you should plot the graph from the times and risk values output by the computer. A risk profile bar graph is constructed on the video screen to show risk profile shape. Since values cannot be interpolated from the video screen, however, a hard copy graph should be plotted by the user.

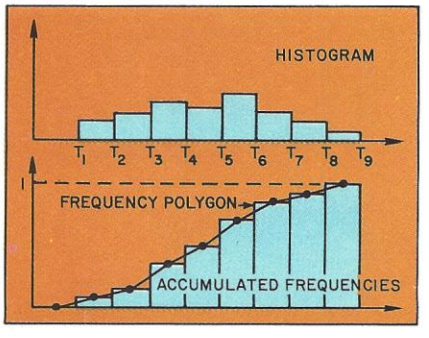

Figure 3—A histogram and frequency polygon can be plotted from computed data.

Remarks on Use of the Program

The times and risks (the probabilities of exceeding those times) can be printed out on a printer by changing the PRINT to LPRINT in lines 1000, 1020 and 1250. The bar-type risk profile cannot be done on a line printer without a special

Program Listing

```
2 DEFINT I - N
5 RANDOM
10 CLS
20 INPUT "TYPE IN NUMBER OF STAGES"; NS
22 PRINT
25 INPUT "ENTER MAXIMUM NR. TASKS PER STAGE"; NT
26 PRINT
30 INPUT "ENTER NUMBER OF MONTE CARLO RUNS WANTED (30-60)"; NR
40 PRINT
50 PRINT "ENTER NR. GROUPS FOR HISTOGRAM OF TOTAL PROJECT RISK."
55 INPUT "(8-14 SHOULD BE USED)"; NG
60 DIM TT(NR), GP(NG), TM(NG), T0(NS,NT), TL(NS,NT), TP(NS,NT),
  TX(NS,NR), T(NS,NR,NT), A(NS,NT,NT)
65 PRINT
70 C0=.01 : C1=.99 : N0=0 : N1=1
72 PRINT "IS TIME OR COST TO BE USED IN THIS RISK ASSESSMENT?"
76 INPUT "ENTER 1 FOR TIME; 2 FOR COST."; KP
80 FOR I = N1 TO NS
90 FOR K = N1 TO NT
95 PRINT
100 PRINT "ENTER MOST OPTIMISTIC VALUE FOR STAGE"; I; "TASK"; K
110 INPUT T0(I,K)
120 PRINT "ENTER MOST LIKELY VALUE FOR STAGE"; I; "TASK"; K
130 INPUT TL(I,K)
140 PRINT "ENTER MOST PESSIMISTIC VALUE FOR STAGE"; I; "TASK"; K
150 INPUT TP(I,K)
160 FOR L = 1 TO NT
165 IF I = N1 GOTO 205
180 PRINT "ENTER TRANSFORMATION MATRIX ENTRY"; K; L; "TO STAGE"; I
200 INPUT A(I,K,L)
202 GOTO 210
205 IF L = K THEN A(I,K,L) = N1
210 NEXT L
220 NEXT K
230 NEXT I
235 PRINT "COMPUTING....."
240 FOR I = N1 TO NS
250 FOR K = N1 TO NT
255 IF TP(I,K) <= 0 GOTO 660
260 H = 2/(TP(I,K) - T0(I,K))
270 A1 = H/(TL(I,K) - T0(I,K))
280 B1 = -A1 * T0(I,K)
290 A2 = -H/(TP(I,K) - TL(I,K))
300 B2 = -A2 * TP(I,K)
320 FL = A1 * (TL(I,K)^2 - T0(I,K)^2)/2 + B1 * (TL(I,K) - T0(I,K))
400 FOR J = N1 TO NR
420 Y = RND (0)
430 TY = (TL(I,K) - T0(I,K)) / (TP(I,K) - T0(I,K)))
450 IF Y > TY GOTO 540
460 T9 = T0(I,K) : A9 = A1 : B9 = B1
470 RD = B9^2 + 2 * A9 * (A9 * T9/2 + B9 * T9 + Y)
480 RD = SQR (RD)
500 T1 = (- B9 - RD)/A9 : T2 = (- B9 + RD)/A9
520 GOTO 580
540 T9 = TL(I,K) : A9 = A2 : B9 = B2 : Y = -FL
560 GOTO 470
580 IF T1 >= T0(I,K) AND T1 <= TP(I,K) THEN T(I,J,K) = T1
600 IF T2 >= T0(I,K) AND T2 <= TP(I,K) THEN T(I,J,K) = T2
640 NEXT J
660 NEXT K
680 NEXT I
700 FOR J = N1 TO NR
720 FOR I = N1 TO NS
730 FOR L = N1 TO NT
735 FOR K = N1 TO NT
740 AA = A(I,K,L)
750 IF AA > C0 GOTO 775
755 NEXT K
760 T(I,J,L) = N0
770 GOTO 790
775 R1 = RND (N0)
778 IF R1 > AA GOTO 755
780 IF I < 2 GOTO 790
782 IF T(I-1,J,K) > C0 GOTO 790
785 GOTO 755
790 NEXT L
795 NEXT I
800 FOR I = N1 TO NS
810 FOR K = N1 TO NT
814 IF KP = 1 GOTO 820
816 IF KP = 2 THEN TX(I,J) = TX(I,J) + T(I,J,K) : GOTO 830
818 PRINT "NEITHER TIME NOR COST WERE SELECTED AS CRITERION."
819 GOTO 2500
820 T3 = T(I,J,K)
825 IF TX(I,J) < T3 THEN TX(I,J) = T3
830 NEXT K
840 TT(J) = TT(J) + TX(I,J)
860 NEXT I
880 TB = TB + TT(J)
900 ST = ST + TT(J)^2
940 NEXT J
960 TB = TB/NR
980 ST = ST/R - TB * TB : ST = SQR (ST)
1000 PRINT "EXPECTED VALUE FOR TOTAL PROJECT IS"; TB
1020 PRINT "STANDARD DEVIATION IS"; ST
1030 TU = 1000000 : TV = N0
1035 FOR I = N1 TO NR
1040 IF TT(I) <= TU THEN TU = TT(I)
1045 IF TT(I) >= TV THEN TV = TT(I)
1050 NEXT I
1055 DL = (TV - TU)/NG
1060 FOR J = N1 TO NR
1070 TD = TU
1075 I = N0
1080 I = I + N1
1090 IF I > NG GOTO 1200
1100 TD = TD + DL
1110 TM(I) = TD - .5 * DL
1120 IF TT(J) <= TD GOTO 1180
1140 GOTO 1080
1180 GP(I) = GP(I) + N1
1200 NEXT J
1220 FOR I = N1 TO NG
1240 CF = CF + GP(I) : GP(I) = CF/NR
1250 PRINT "PROBABILITY OF EXCEEDING TIME (OR COST)"; TM(I); "IS";
1-GP(I)
1260 INPUT "TO DRAW RISK PROFILE GRAPH, HIT ENTER"; QK
1270 CLS
1280 FOR I = N1 TO NG
1290 GL = INT(GP(NG) + .2) * 30 : IF GL > 40 THEN GL = 40
1300 FOR K = GP(I) * 30 + 3 TO GL + 3
1320 SET (8 * I, K)
1340 SET (8 * I + 2, K)
1360 NEXT K
1370 NEXT I
1380 PRINT @961, TU;
1390 PRINT @900, "+";
1400 PRINT @959 + 4 * NG - 1, TV;
1410 PRINT @895 + 4 * NG + 2, "+";
1420 PRINT @(GP(1) * 30/2), 1-GP(1);
1440 PRINT @640, "0";
1460 PRINT @15, "Y-AXIS = PROBABILITY OF EXCEEDING TIME (OR COST)";
1470 PRINT @885, "TIME UNITS";
1500 FOR K = 1 TO 127 : SET (K,33) : NEXT K
1520 PRINT @428, "HIT ENTER TO STOP";
1530 INPUT QQ
2500 END
```

software routine.

This program is short (less than 4K) but requires a tremendous amount of "number crunching" in its execution for even a moderately-sized project. Considerable RAM memory is required for matrices when the project is large. A project such as the construction of a nuclear carrier is beyond the capability of a 64K machine, but this program could assess the risk of such a project given a large enough machine. Small projects can be assessed with 32K, but 16K could result in an Out of Memory (OM) error.

The TRS-80 is slow enough that you could put in the requested data and then go to get a cup of coffee, herbal tea or even lunch. This program should be compiled to run efficiently but if you don't have compiler software, the TRS-80 will have to crunch numbers the hard way.

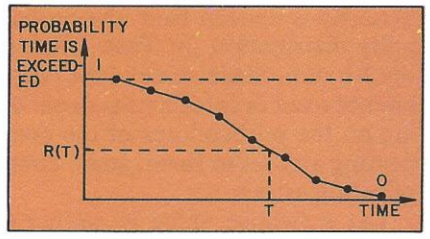

Figure 4—A risk profile can be drawn from frequency polygon data.

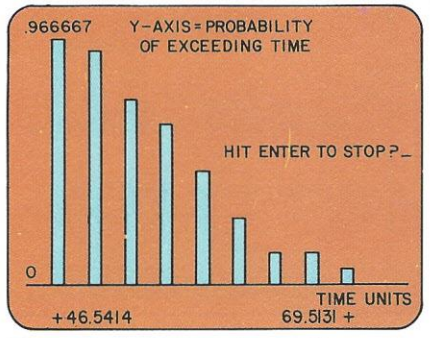

Figure 5—A bar-type risk profile graph is drawn on the video screen.

Risk management for a project can be accomplished by doing several risk assessments for task estimate values that are adjusted to new information, reallocation of resources to tasks that are bottlenecks, and the creative insertion or deletion of tasks. Safe times (or costs) are those for which the risk is .10 or less. Use of this program can give a manager insight by allowing him or her to compare different situations. Risk management consists of changing a project design via new technology, reallocations of resources, goals, etc., to lower the risk for the project.

This program is an excellent tool for scientific management operations analysis. It can save time and money by showing that a project should be redesigned or scrapped, and can aid in the design itself.

Sample Run

Let us choose a time risk example which has the network flow shown in the Figure 1 graph. We will also use that figure's stage transition matrices. The figure has three stages with the maximum number of tasks in any one stage also being three. The computer will ask for the most optimistic time, most likely time and most pessimistic time for three times three or nine tasks. Since there are only two tasks in each of Stages 1 and 3, we will input zeros for the third tasks in Stage 1 and Stage 3. It may be easier to understand Stages 1 and 3 with all arrows leaving or entering those tasks having zeros associated with them.

For the sake of this example, let the following be the values for the most optimistic, most likely and most pessimistic times for the various tasks in months:

Time in Months

TASK	TO	TL	TP
1,1	10	12	20
1,2	5	10	16
(1,3)	(0)	(0)	(0) dummy
2,1	5	9	12
2,2	4	10	14
2,3	3	5	10
3,1	20	30	50
3,2	22	28	40
(3,3)	(0)	(0)	(0) dummy

Now we begin by entering RUN. All characters are printed by the computer on the video screen except those underlined, which we enter from the keyboard.

TYPE IN NUMBER OF STAGES? 3
ENTER MAXIMUM NR. TASKS PER STAGE? 3
ENTER NR. MONTE CARLO RUNS WANTED (30-60)? 30
ENTER NR. GROUPS FOR HISTOGRAM OF TOTAL PROJECT RISK. (8-14 SHOULD BE USED)? 9
IS TIME OR COST TO BE USED IN THIS RISK ASSESSMENT? ENTER 1 FOR TIME; 2 FOR COST? 1
ENTER MOST OPTIMISTIC VALUE FOR STAGE 1 TASK 1? 10
ENTER MOST LIKELY VALUE FOR STAGE 1 TASK 1? 12
ENTER MOST PESSIMISTIC VALUE FOR STAGE 1 TASK 1? 20
ENTER MOST OPTIMISTIC VALUE FOR STAGE 1 TASK 2? 5
ENTER MOST LIKELY VALUE FOR STAGE 1 TASK 2? 10
ENTER MOST PESSIMISTIC VALUE FOR STAGE 1 TASK 2? 16
ENTER MOST OPTIMISTIC VALUE FOR STAGE 1 TASK 3? 0
ENTER MOST LIKELY VALUE FOR STAGE 1 TASK 3? 0
ENTER MOST OPTIMISTIC VALUE FOR STAGE 2 TASK 1? 5
ENTER MOST LIKELY VALUE FOR STAGE 2 TASK 1? 9
ENTER MOST PESSIMISTIC VALUE FOR STAGE 2 TASK 1? 12
ENTER TRANSFORMATION MATRIX ENTRY 1 1 TO STAGE 2? 1
ENTER TRANSFORMATION MATRIX ENTRY 1 2 TO STAGE 2? 1
ENTER TRANSFORMATION MATRIX ENTRY 1 3 TO STAGE 2? 0
ENTER MOST OPTIMISTIC VALUE FOR STAGE 2 TASK 2? 4
ENTER MOST LIKELY VALUE FOR STAGE 2 TASK 2? 10
ENTER MOST PESSIMISTIC VALUE FOR STAGE 2 TASK 2? 14
ENTER TRANSFORMATION MATRIX ENTRY 2 1 TO STAGE 2? 0
ENTER TRANSFORMATION MATRIX ENTRY 2 2 TO STAGE 2? .6
ENTER TRANSFORMATION MATRIX ENTRY 2 3 TO STAGE 2? .4
ENTER MOST OPTIMISTIC VALUE FOR STAGE 2 TASK 3? 3

(continue inputting values from time criteria table and transition matrices as done above)

ENTER TRANSFORMATION MATRIX ENTRY 3 3 TO STAGE 3? 0

COMPUTING .....

EXPECTED VALUE FOR TOTAL PROJECT IS 58.526
STANDARD DEVIATION IS 5.18724

PROBABILITY OF EXCEEDING TIME 47.8176 IS .966667
PROBABILITY OF EXCEEDING TIME 50.37 IS .966667
PROBABILITY OF EXCEEDING TIME 52.9224 IS .733333
PROBABILITY OF EXCEEDING TIME 55.4748 IS .633333
PROBABILITY OF EXCEEDING TIME 58.0272 IS .433333
PROBABILITY OF EXCEEDING TIME 60.5796 IS .233333
PROBABILITY OF EXCEEDING TIME 63.1321 IS .1
PROBABILITY OF EXCEEDING TIME 65.6845 IS .1
PROBABILITY OF EXCEEDING TIME 68.2369 IS .0333334
TO DRAW RISK PROFILE GRAPH, HIT ENTER? ⟨Enter⟩

Thus we expect that the project will take about 58.5 months to complete. If we were worried about completing the project within 60 months, we would read the fifth output line from the bottom to get the risk (probability of exceeding 60 months) of .23. This is almost a fourth. The manager of the project may then reallocate resources to the tasks (more to task 3,1, for example) and reassess the risk until he is satisfied that nothing further can be or need be done.

The risk profile is graphed by plotting the output probabilities versus time (horizontal axis.).

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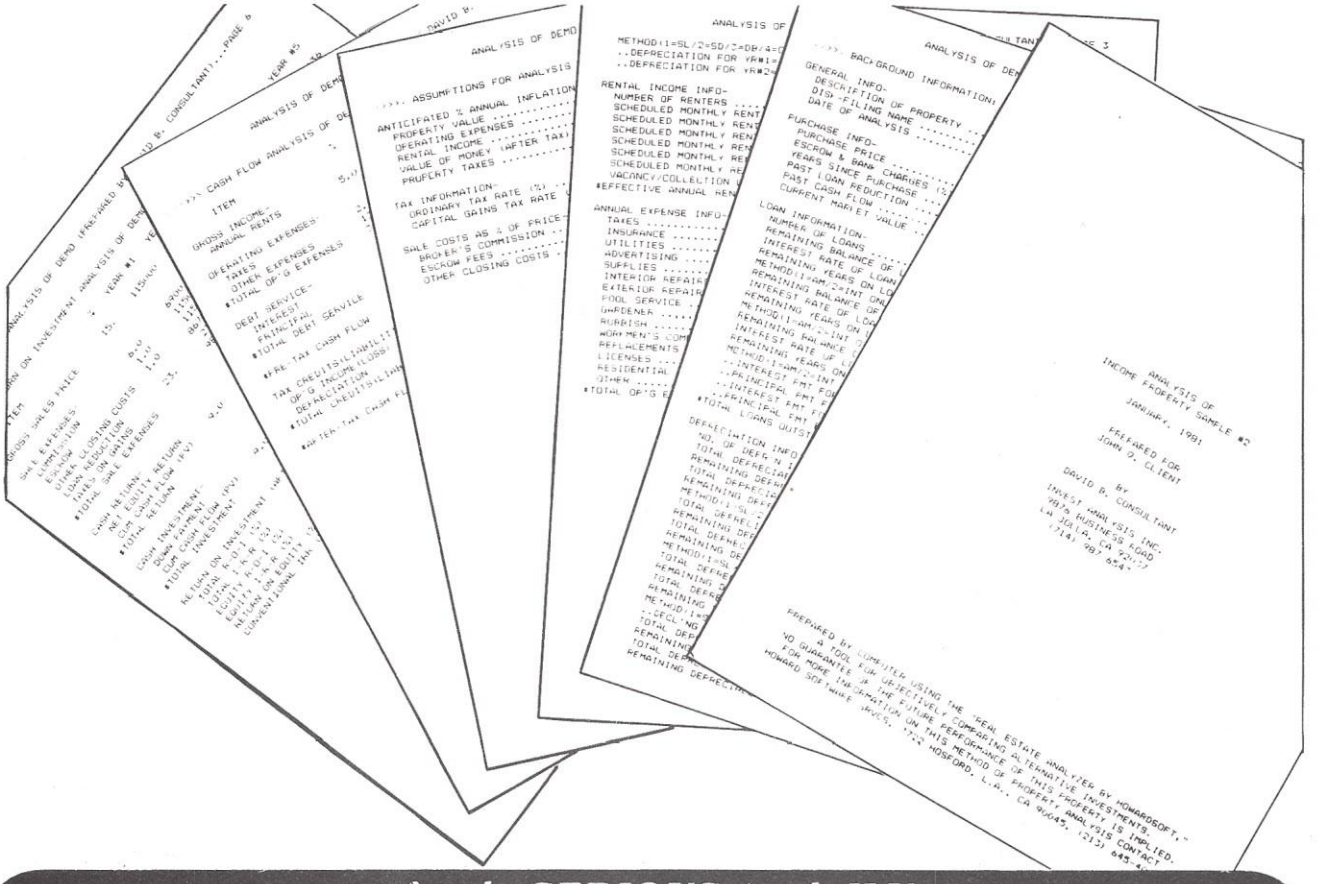

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CIRCLE 22

Simulation

(*continued from page 31*)

tested as the model was built. The overall simulation was tested by examining the existing non-appointment system. An eight-hour (480-minute) day was used, since this was Dr. Evans's normal procedure. Two hundred days were simulated.

Table 1 presents the means and standard deviations generated by the model of the existing system. As you can see, Dr. Evans's concern was justified. According to the model, he could expect to be idle at the clinic better than 22 percent of the time, and he could expect a maximum period of idleness of 37 minutes each day. Each patient averaged almost 32 minutes of waiting with the maximum wait averaging almost an hour and a half. Usually there was one patient in the waiting room when a new one arrived. An average of 20 patients a day were treated, and the doctor could expect to spend 530 minutes in the clinic each day; he wouldn't leave until 50 minutes after the clinic was closed.

I went over these results with Dr. Evans, who said he believed they agreed closely with his own observations. As a further check, I spent several more days looking at the clinic's operation, paying particular attention to idleness and waiting time. The new observations also confirmed the model's results.

In my first crack at an appointment system, I spaced the appointments 24 minutes apart. This was done to allow the doctor to see approximately the same number of patients in a 480-minute day (Table 2).

Exercise and Evaluation

The results were somewhat better than those produced by the non-appointment system. Now the doctor would be idle only 16 percent of the time, with an average maximum period of idleness of 16 minutes. The patients would average 27 minutes waiting, with an average maximum of 73.4 minutes. The queue length would drop a little, and the total time the doctor spent in the clinic would be reduced by 14 minutes.

Still this did not meet the doctor's objective of substantial reductions in patient waiting time. I thought perhaps a change in the appointment interval with a corresponding change in the length of time the clinic was open (to keep the number of patients seen each day to around 20) might yield improvement. Table 3 shows the results with 20 minutes between appointments and Table 4 with an interval of 30 minutes.

A dilemma was apparent. Reducing the appointment interval caused the doctor's idleness to drop to acceptable limits, but increased the patient waiting time. Increasing the appointment interval reduced patient waiting time, but increased the doctor's idleness. It was obvious that additional investigation was necessary.

Final recommendation

My final recommendation to Dr. Evans, after many other simulation runs were made, was to have a flexible appointment interval, keyed to the expected service time of the patient. He agreed and adopted this model. Now when a patient calls in, the nurse/receptionist schedules the appointment on the basis of symptoms or desired service. Significant reductions in idleness and waiting time have resulted.

The only thing that prevents this

```
ENTER APPOINTMENT INTERVAL (Ø=RANDOM) ? Ø
ENTER # OF POINTS IN ARRIVAL TIME DISTRIBUTION? 12
FOR POINT # 1 ENTER TIME AND CUMULATIVE PERCENTAGE?  5,9
FOR POINT # 2 ENTER TIME AND CUMULATIVE PERCENTAGE?  1Ø,39
FOR POINT # 3 ENTER TIME AND CUMULATIVE PERCENTAGE?  15,49
FOR POINT # 4 ENTER TIME AND CUMULATIVE PERCENTAGE?  2Ø,56
FOR POINT # 5 ENTER TIME AND CUMULATIVE PERCENTAGE?  25,64
FOR POINT # 6 ENTER TIME AND CUMULATIVE PERCENTAGE?  3Ø,71
FOR POINT # 7 ENTER TIME AND CUMULATIVE PERCENTAGE?  35,78
FOR POINT # 8 ENTER TIME AND CUMULATIVE PERCENTAGE?  4Ø,84
FOR POINT # 9 ENTER TIME AND CUMULATIVE PERCENTAGE?  45,9Ø
FOR POINT # 1Ø ENTER TIME AND CUMULATIVE PERCENTAGE?  5Ø,95
FOR POINT # 11 ENTER TIME AND CUMULATIVE PERCENTAGE?  55,98
FOR POINT # 12 ENTER TIME AND CUMULATIVE PERCENTAGE?  6Ø,1ØØ
```

Figure 7—The video display after the arrival time distribution of the patients has been entered into the computer.

```
** ITERATION # 1 **
PAT          ARR   BGN   SRV   END   WAIT  IDLE  LINE
#     CLS    T     T     T     T     T     T     LNG
  1    1     3Ø    3Ø    1Ø    4Ø    Ø     3Ø    Ø
  2    1     55    55    15    7Ø    Ø     15    Ø
  3    1     1Ø5   1Ø5   1Ø    115   Ø     35    Ø
  4    1     115   115   1Ø    125   Ø     Ø     Ø
  5    1     125   125   4Ø    165   Ø     Ø     Ø
  6    1     15Ø   165   1Ø    175   15    Ø     Ø
  7    1     16Ø   175   1Ø    185   15    Ø     1
  8    1     17Ø   185   15    2ØØ   15    Ø     1
  9    1     21Ø   21Ø   1Ø    22Ø   Ø     1Ø    Ø
 1Ø    1     245   245   1Ø    255   Ø     25    Ø

MORE DATA, PRESS ENTER WHEN READY?
```

Figure 8—Printout showing the times associated with each patient.

```
FRACTION OF TIME IDLE WAS
  55.2ØØ3 PERCENT.
AVERAGE WAITING TIME WAS
  3.33333 MINUTES.
AVERAGE NUMBER WAITING
  WAS .133333.
MAXIMUM IDLE TIME WAS 45
  MINUTES.
MAXIMUM WAIT WAS 15 MIN.
MAXIMUM LINE LENGTH WAS 1.
PRESS ENTER TO CONTINUE? _
```

Figure 9—Video display summary of each day's results.

	MEAN	STD DEV
MX IDLE	36.9	11.7
MX WAIT	87.3	52.1
MX LINE	3.1	2.1
AV IDLE	22.1	12.7
AV WAIT	31.7	28.5
AV LINE	1.Ø	1.1
NUM PAT	20.2	3.2
OFF TIM	530.3	56.2

Figure 10—Statistical parameters computed for each variable.

```
** HISTOGRAM FOR AVERAGE PERCENT IDLE

 0.00   6.0  **************                                    14
 6.02  12.04 ************************************             37
12.04  18.06 ************************************             37
18.06  24.08 **********************************               35
24.08  30.10 ***************************                      28
30.10  36.12 **************                                   15
36.12  42.14 ******************                               19
42.14  48.16 *********                                          8
48.16  54.18 ******                                             6
54.18  60.20 *                                                  1
        0         10        20        30        40
PRESS ENTER WHEN REVIEW COMPLETE? _
```

Figure 11—User has the option of displaying variable histogram.

Table 1. Results with random arrivals

	Mean	Std Dev
Maximum Idle Time (min.)	36.9	11.7
Maximum Waiting Time (min.)	87.3	52.1
Maximum Line Length	3.1	2.1
Average Idle Time (%)	22.1	12.7
Average Waiting Time (min.)	31.7	28.5
Average Line Length	1.0	1.1
Number of patients seen	20.2	3.2
Time spent in office (min.)	530.3	56.2

Table 2. Results with 24-minute appointments

	Mean	Std Dev
Maximum Idle Time (min.)	16.1	4.9
Maximum Waiting Time (min.)	73.4	46.5
Maximum Line Length	2.4	1.7
Average Idle Time (%)	16.1	11.3
Average Waiting Time (min.)	26.9	26.4
Average Line Length	0.7	0.8
Number of patients seen	20.7	0.9
Time spent in office (min.)	516.3	48.3

Table 3. Results with 20-minute appointments

	Mean	Std Dev
Maximum Idle Time (min.)	10.6	5.4
Maximum Waiting Time (min.)	97.8	58.0
Maximum Line Length	3.8	2.2
Average Idle Time (%)	9.0	8.1
Average Waiting Time (min.)	41.7	32.7
Average Line Length	1.4	1.2
Number of patients seen	20.7	0.9
Time spent in office (min.)	470.3	64.0

Table 4. Results with 30-minute appointments

	Mean	Std Dev
Maximum Idle Time (min.)	23.9	2.2
Maximum Waiting Time (min.)	53.1	31.1
Maximum Line Length	1.4	1.0
Average Idle Time (%)	28.4	11.2
Average Waiting Time (min.)	12.9	12.8
Average Line Length	0.3	0.4
Number of patients seen	20.6	0.8
Time spent in office (min.)	609.7	32.7

model from being applied universally to waiting-line problems involving one server is the inclusion of priority customers. If you remove the coding that concerns priority shifting—or, easier yet, force all customers to be Priority 1 by making C(I) always equal to 1—the model will fit any situation with random or constant arrival times, random or constant service times, and a first-in/first-out queue discipline.

If you know the actual probability function related to times between arrivals or service times, you need not enter the cumulative distribution. Instead you can have the model generate the times from the appropriate distribution. (The generation of non-uniform random variables was discussed at length in the second article in this series.)

Of course, if your problem has peculiarities, such as a limit on queue length, with customers lost if the queue is full, you will have to change the model accordingly. You might have a case where there are two doctors (or tellers or checkout clerks), with arrivals joining the shortest line. This would require programming for parallel service and adjusting the queue discipline. In another situation, a customer might be served on one line and then join another queue to await further service. The interaction of arrivals to the system and service times of the first server generates the arrivals to the second service facility. Here you would need two queueing models in sequence, the output of the first being the input to the second.

Any number of other cases can be handled by modification of the simulation presented in this article. Go to it, and if you run into problems, drop me a note in care of *Personal Computing*. I'll at least try to point you in the right direction. □

(*Program Listing on page 87.*)

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Cooper, R. B., *Introduction to Queueing Theory,* The Macmillan Co., New York, 1972.

Moder, J. J., and Elmaghraby, S. E., editors, *Handbook of Operations Research,* Vol. 1, Section III-2, Van Nostrand Reinhold Co., New York, 1978.

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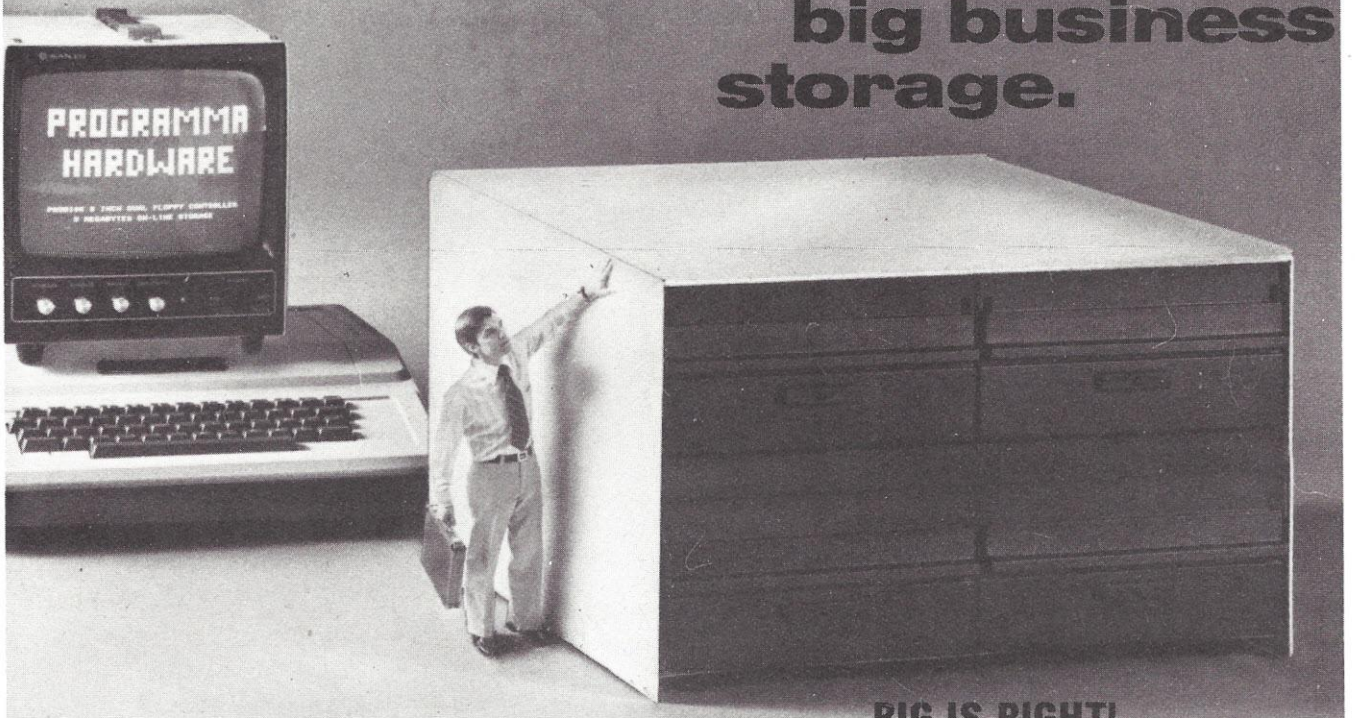

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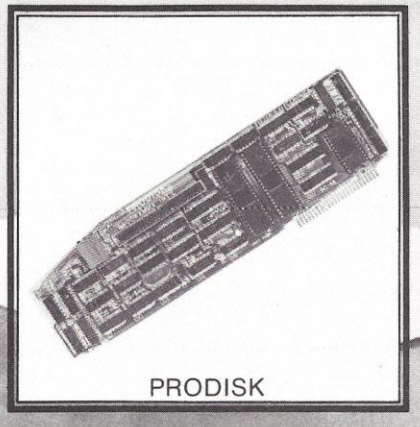

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CIRCLE 23

Kathe Spracklen
4278 Calle De Vida
San Diego, CA 92124

Dear Fellow Computer Chess Enthusiast:

Hayden Publishing Company has asked me to serve as the Computer Chess column editor for Personal Computing magazine. I accepted with great eagerness.

I have been active in the field of computer chess for over three years and during that time I have taken on many roles: student, programmer, speaker, writer, and educator. I have enjoyed them all. I love computer chess! Along with my responsibility to Personal Computing magazine, I have also been asked to serve as chairman of the Publications Committee of the International Computer Chess Association. So, from two vantage points, I will try the new role of computer chess publicist. As publicist, I see my major function as being the accumulation and dissemination of news and ideas of interest to the computer chess community.

As I put together my thoughts on what this Computer Chess column should be, however, I found myself pondering an important question voiced most frankly by Contributing Editor Evan Katz when he asked, "Can you really be objective as editor, since you have a program which stands to benefit from your reporting?"

Evan's question is a tough one. I am employed by Fidelity Electronics, a major manufacturer of home chess computers, and I am aware that it is impossible to spend the countless hours it takes to develop a computer chess program without acquiring an emotional stake in the finished product. If I serve objectively, it is because I recognize and respect these same feeling in others. I take objectivity to be a serious responsibility, and I invite you, the reader, to "call me down" if you think I fail. My optimism in believing I will remain objective stems from the focus I hope to achieve in the Computer Chess column. My intention is to focus less on how a program compares to others and to concentrate more on what makes a program unique.

Computer chess is intensely competitive and is always exciting. People all over the world, from university computer centers to hobbyists' workbenches, are working on this problem. With contributions being made daily, it's a challenge to keep abreast of this fast moving field—a challenge that I'm eager to meet and one that I hope you'll share with me.

Sincerely,

Kathe Spracklen

Kathe Spracklen

The Past, Present and Future

BY KATHE SPRACKLEN

The Computer Chess column of *Personal Computing* magazine goes back a long way and its history begins with the formation of a separate publication, the *Computer Chess Newsletter,* founded in 1977 with Doug Penrod as editor. At that time, Penrod expressed the goal of the new publication as follows:

> There has been a great rise in interest in computer chess, and I feel that the time is ripe for a publication to serve as a means for exchange of information among writers of computer chess programs and to provide information for those interested in playing computer chess. . . . Most chess programs are developed independently, and much effort is spent on reinvention. Perhaps by sharing information, comparing programs and program philosophies, etc., the state of the art could be advanced more rapidly.

The first issue of the *Computer Chess Newsletter* carried the news that "two chess-playing machines have been announced; one is now on the market for $200 or less." Three chess programs for microcomputers were listed for sale in the issue including Microchess by Peter Jennings for the 8080 and KIM-1 and a BASIC language program by Randy Miller for the MITS Altair. The field of microcomputer chess was in its infancy and Doug's newsletter announced its birth. Response to the publication was immediate and enthusiastic.

About the same time that Penrod was founding the *Computer Chess Newsletter,* a parallel development in computer chess organization and information exchange was taking place: the International Computer Chess Association (ICCA) was formed by the participants of the Second World Computer Chess Championship. That organization, under the editorial direction of Professor Ben Mittman, established the *ICCA Newsletter.* Most of the programmers active in computer chess, as well as many others interested in the field, joined the ICCA. So, from the very beginning, there have been two publications covering computer chess news and ideas: one casual in nature, the other more academic.

Unfortunately, Doug Penrod couldn't continue with his newsletter because he was dying of cancer and in April of 1978 Computer Chess became a monthly column in *Personal Computing.*

Now, with the column in its third year, I am assuming responsibility as editor. As I contemplate the direction of the column, I see its focus as being based on Doug Penrod's original vision: a medium for the exchange of computer chess information—casual, tutorial and approachable.

Ultimately, however, the structure of this column will be up to you. You will determine the structure through your comments and suggestions, and by your submissions. Because our directions will be determined over the next few months, you must take the time to express your opinions now.

To stimulate your thoughts on the matter, I have gone over some of the aspects of the column for the past three years and I am presenting some of my ideas.

The Bulletin Board: David Slate (*Chess 4.9* and *Newchess*) once described the Computer Chess column as a bulletin board. Space permitting, any and all persons could put up whatever notices they wished to the computer chess community. When Dan *(husband Dan Spracklen of Sargon fame)* and I were first getting into computer chess, we used the bulletin board aspect of the column to publicize our new program. Several others in the field have done this as well. It is my belief that bulletin board items have a place in this column but they should be clearly marked as such. Unsolicited bulletin board material should be published on a space-available basis.

Events Reporting: I feel that major computer chess tournaments deserve full journalistic coverage, and, because such coverage demands a great deal from a reporter, I think reports of this nature deserve article status. Unfortunately, detailed reporting by an objective observer is not always available, so, in those instances, the Computer Chess column will try to fill the breach by reminiscing with tournament participants and by analyzing the games played.

Announcement of Upcoming Events: The Computer Chess column has always announced and publicized upcoming computer chess events. Such announcements are vital to insure the widest possible range of participants and to enable new programs to enter the field. I believe this policy should be continued.

Analysis of Computer Chess Games: Chess masters can continue to tell us how various computer programs stand in regard to preferred play during program encounters. Analyses offer programmers new directions for research to correct revealed weaknesses in a program's play. I would like to augment a master's analysis with separate discussions about the same game by the programmers who could tell us why their programs made certain key moves.

Technical Discussions: From time to time, the Computer Chess column has carried technical articles in the field of computer chess. I think that such materials, when well-written, deserve the status of separate articles within *Personal Computing.* All submissions of this nature sould be directed to my attention.

Fredkin Incentive Awards

Two computer chess incentive competitions sponsored by the Fredkin Foundation, which set up a $100,000 prize for the first computer program that beats the World Chess Champion in official competition, have now been held. Although a program that defeats the world champion is several years away, the foundation has established a series of incentive prizes. Each year the two top computer chess programs play against humans of a specified skill level with the humans chosen at random from the United Chess Federation rating list. Here are the results of the latest incentive matches.

In the first of the contests, *Chess 4.9,* developed by David Slate of Northwestern University, Larry Atkin, formerly of Northwestern, and David Cahlander of Control Data Corporation, played a two-game match against Paul Benjamin, an expert-ranked chess player from New York. The match was split 1-1 with the two sides sharing a $1500 prize equally.

In the second incentive competition, held at Carnegie-Mellon University, *Belle* by Ken Thompson and Joe Condon of Bell Telephone Labs, was pitted against expert-ranked Jack Gibson of Arizona. The two-game contest and the $1000 prize went to *Belle* with its score of 1½ to ½.

Here are the games from the two matches.

Fredkin Challenge Match I

Game 1
Sicilian Defense

White	Black				
Chess 4.9	*Benjamin*	20. Bd3	Bc3	41. Rb2	e4
		21. Ba6	Rc6	42. Rf4	d3
1. e4	c5	22. Bb5	Rc8	43. cd3	Rc1
2. Nf3	d6	23. Bd3	Bd7	44. de4	Rc5
3. d4	cd4	24. Be3	d4	45. a4	Rb7
4. Nd4	Nf6	25. Bf4	Bf5	46. ef5 check	Rf5
5. Nc3	g6	26. Bf5	gf5	47. Rc4	Rd5
6. Be2	Bg7	27. a3	f6	48. Re2 check	Kd7
7. 0-0	0-0	28. Bh6	Rc6	49. Rce4	Kc8
8. Bg5	Nc6	29. b5	Rb6	50. Re8 check	Rd8
9. Nc6	bc6	30. Rb3	Rc8	51. R8e4	Rbd7
10. Qd2	Rb8	31. Rd1	Rc5	52. Re6	Rd6
11. Rb1	Re8	32. Rdb1	Rc4	53. Re7	R8d7
12. b4	Be6	33. g3	e5	54. Re8 check	Bd8
13. Bh6	Bh8	34. Kg2	Kf7	55. g4	Kb7
14. h3	d5	35. Bc1	Ba5	56. R2e4	Rd4
15. ed5	Nd5	36. Rf3	Ke6	57. Rd4	Rd4
16. Nd5	Qd5	37. Rb2	Bc3	58. Kf3	Rd6
17. Qd5	cd5	38. Rb3	Ba5	59. Rf8	Rd7
18. Bf4	Rbc8	39. Rb2	Bc3	60. h4	Kb6
19. Bb5	Red8	40. Rb3	Ba5	Adjudicated a win for Black	

Game 2
Pirc Defense Reversed

White	Black				
Benjamin	*Chess 4.9*	11. de4	Qd3	24. Ba4	ab4
		12. Bb2	Ne4	25. cb4	Bb4
1. Nf3	d5	13. Ne4	Qe4	26. Rd1	Bc5
2. g3	Nc6	14. Nd4	Qg6	27. Rd2	Bd4
3. d3	e5	15. Nc6	bc6	28. Bd4	ed4
4. Nbd2	Nf6	16. Re1	a5	29. Bb5	Qe5
5. Bg2	Be7	17. Bc6	Rad8	30. Bf1	g6
6. 0-0	0-0	18. Qa4	Qf6	31. a4	c5
7. e4	Kh8	19. Re2	Bc4	32. a5	Qe1
8. c3	Bg4	20. Rc2	Bd3	33. Ra2	d3
9. h3	Be6	21. Rd2	Bb5	34. a6	d2
10. b4	de4	22. Rd8	Ba4	35. a7	Qf1 check
		23. Rf8 check	Bf8	Resigns	

Fredkin Challenge Match II

Game 1
Indian defense

White	Black				
Gibson	*Belle*	20. Qc5	bc5	41. Ke4	Kd6
		21. Bc4	Bf5	42. Bf5	Bg1
1. d4	Nf6	22. Ng5	Rd2	43. Bc8	Bf2
2. Nf3	g6	23. Ne6	Be6	44. Bg4	Be1
3. Nbd2	Bg7	24. Be6 check	Kd8	45. Bc8	Bc3
4. e3	d6	25. Rad1	Rff2	46. Bg4	Bb4
5. Bd3	Nc6	26. Rd2 check	Rd2	47. Bc8	Be1
6. c3	Rg8	27. Rf2	Bh6	48. Bg4	Bd2
7. e4	e5	28. Rd2 check	Bd2	49. Bc8	Bf4
8. 0-0	Bg4	29. Bd5	Ke7	50. Bg4	Bc1
9. h3	Bd7	30. Kf2	Bc1	51. Bc8	Bd2
10. de5	Ne5	31. b3	c4	52. Bg4	Bf4
11. Ne5	de5	32. Bc4	Bb2	53. Bc8	Bc1
12. Nf3	Qe7	33. Kf3	Bc3	54. Bg4	c6
13. Qb3	0-0-0	34. Bd3	Kd6	55. Bc8	Bf4
14. Bc4	Ne4	35. Bc4	Bd4	56. Bg4	Bd2
15. Bf7	Rgf8	36. Bg8	Ke7	57. Bc8	Bc1
16. Bd5	Nc5	37. Bd5	a5	58. Bg4	Bf4
17. Qb4	b6	38. a4	h5	59. Bc8	Bd2
18. Be3	Bh3	39. Be4	g5	60. Bg4	c5
19. Bc5	Qc5	40. Bg6	h4	Adjudicated a Draw	

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This comprehensive Diskette Cataloguing/Indexing utility allows the user to keep track of thousands of programs in a categorized library. Machine language program works with all TRSDOS and NEWDOS versions. Files include program names and extensions, program length, diskette numbers, front and back, and diskette free space.

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This ISAM-based maillist minimizes disk access times. Four keys — no separate sorting. Supports 9-digit zip code and 3-digit state code. Up to 30 attributes. Mask and query selection. Record access times under 4 seconds!!

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CIRCLE 24

Fredkin Challenge Match II

Game 2
Ruy Lopez

White *Belle*	Black *Gibson*
1. e4	e5
2. Nf3	Nc6
3. Bb5	a6
4. Ba4	Nf6
5. 0-0	d6
6. Bc6 check	bc6
7. d4	Ne4
8. de5	d5
9. Nbd2	Bg4
10. c3	Nd2
11. Bd2	Be7
12. Qa4	Qd7
13. e6	Be6
14. Ne5	Qd6
15. Bf4	Qc5
16. Qc6 check	Qc6
17. Nc6	Bf6
18. Rfe1	0-0
19. Be5	Be5
20. Ne7 check	Kh8
21. Re5	Rfd8
22. Rae1	Rd7
23. Nc6	Rd6
24. Nd4	Re8
25. b4	g6
26. f4	Kg8
27. f5	gf5
28. Nf5	Rc6
29. R1e3	Kf8
30. Nd4	Rd6
31. Rh5	Kg8
32. Ree5	c6
33. Reg5 check	Kh8
34. Rh6	Rg8
35. Rgh5	Rg6
36. Rh7 check	Kg8
37. Rh8 check	Kg7
38. R5h7 check	Kf6
39. Ra8	Ke5
40. Ra6	Ke4
41. Rc6	Rc6
42. Nc6	Bd7
43. Rh4 check	Rg4
44. Rg4 check	Bg4
45. h4	f6
46. b5	Kd3
47. Ne7	Kc3
48. b6	d4
49. b7	d3
50. b8/Q	d2
51. Qb3 check	resigns

Computer Chess Ratings

During 1980, the United States Chess Federation allowed rather open participation of computer chess programs in USCF-rated tournaments. Anyone who owned a machine could enter it in any tournament. Owner/program combinations were given a separate rating, but those ratings were never published in the regular *Chess Life* rating issue. *Sargon 2.5,* for example, had at least a half-dozen separate ratings. (Under Chafitz sponsorship, *Sargon 2.5* had a nonprovisional rating of 1474; *Mychess,* by David Kittenger, showed a nonprovisional rating of 1615.)

Recently, the USCF announced that only the program authors or sponsors may register machines, and some of the other regulations, such as the higher membership fee of $30 for computer programs and the restriction that computers can only win prizes specifically designated for them, seem discriminatory against programs.

The real "Catch-22" of the new policy, however, is the announcement requirement. The new regulations state that "an event in which computers will (or may) participate must be so designated in the *Tournament Life* announcement or any other advance written publicity." Ken Thompson *(Belle)* points out that tournament directors are not being notified of this advance announcement requirement.

The result of the new regulations is that computer programs are effectively being barred from participation in USCF-rated events, at least for the next several months. If the USCF continues to block the rating of computer chess programs, this vital issue will be back entirely in the hands of the ICCA. The ICCA has established a committee to study the subject. If you are interested in the question of how to rate or rank computer chess programs, you may be interested in serving on the committee.

Much of the ICCA's work takes place within committees such as those on publications and publicity, ranking, tournament organizing, sanctioning, program rights and standards, and liaison. I strongly encourage all individuals interested in computer chess to become members of the ICCA and I further encourage all members of that organization to serve on committees. Membership dues in the ICCA are $10 for 1980 and payment must be in U.S. currency, check or money order. Send payment along with your name, address and the name of a committee(s) on which you would like to serve to: Ken Thompson, Bell Telephone Labs, Room 2C423, Murray Hill, NJ 07974.

(*continued from page 48*)

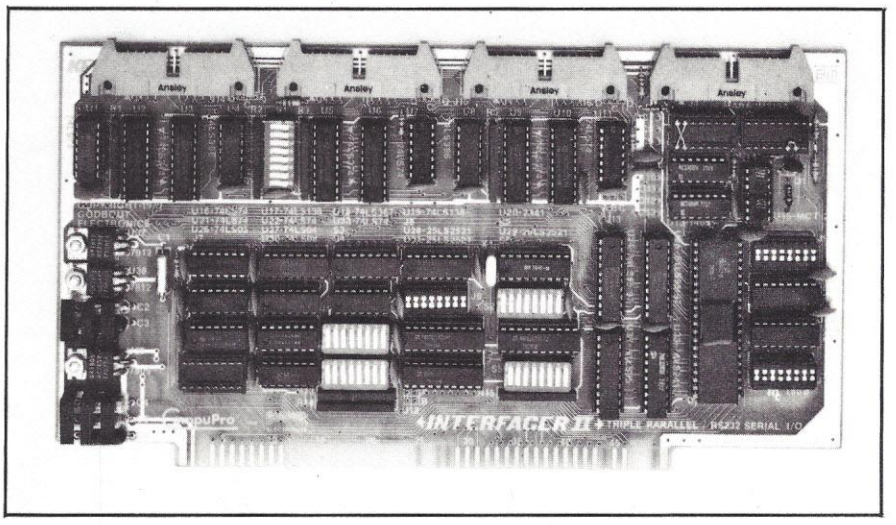
in understanding exactly what the interface is. It is simply a specification of the type of connector and voltage levels that are to be used for serial data transfer. In addition some of the pins on the interface connector have specific designations, while others do not. As a result, different manufacturers use the undefined pins differently, resulting in incompatibility.

Another problem area is the connectors. The RS-232C specification says that a male 25-pin connector should be attached to the terminal equipment (CRTs, printers, etc) and that the female connector should be attached to the communications equipment (computers, modems, etc.). Failure to adhere to this, or trying to connect two terminal devices together can result in the need for a special adapter that will mate the incompatible connectors.

The most common pins used on the serial connector are 2, 3 and 7 which are the pins for transmitted data, received data and signal ground respectively. Pin 1, protective ground, is also frequently used. The thing that causes the most headaches in a serial interface is the handshaking. Any one of three pins could be used for handshaking in any particular case. These are pins 4, 5 and 20. Assuming you've found the correct pin for handshaking, you're still not home free yet, because its possible for the polarity of the handshaking signal to be positive or negative.

Once you've figured out the hardware connections correctly, you still have to worry about speed. In this case, speed refers

(*continued on page 97*)



Three full duplex, parallel ports, a serial port and a selectable rate interrupt timer are all available on the Interfacer II S-100 interface board from Godbout Electronics.

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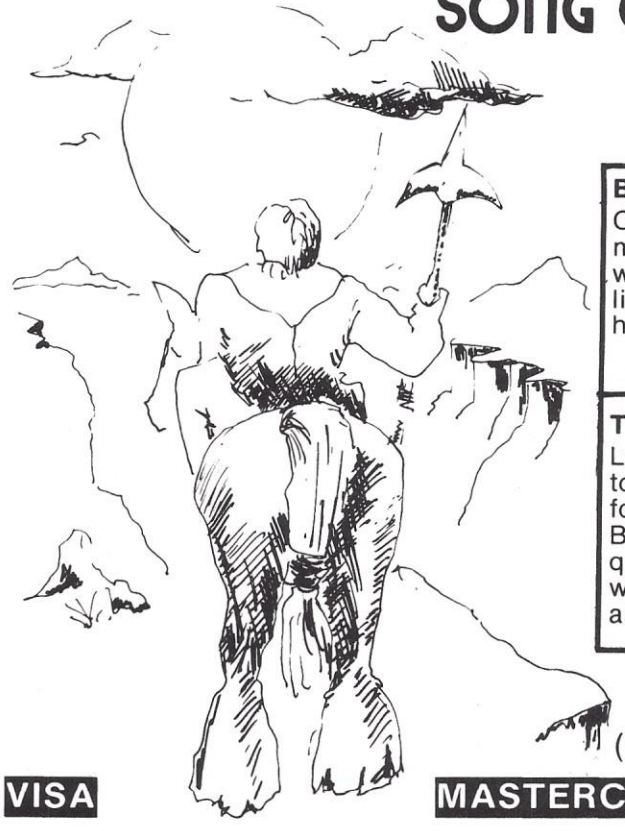

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CIRCLE 29

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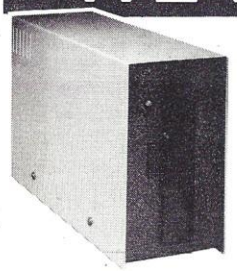

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Letter quality printers. Use up to 15" paper. 1 year warranty on parts. 3 months on labor. Proportional spacing and bidirectional printing. Same as VISTA V300.

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ACCESSORIES

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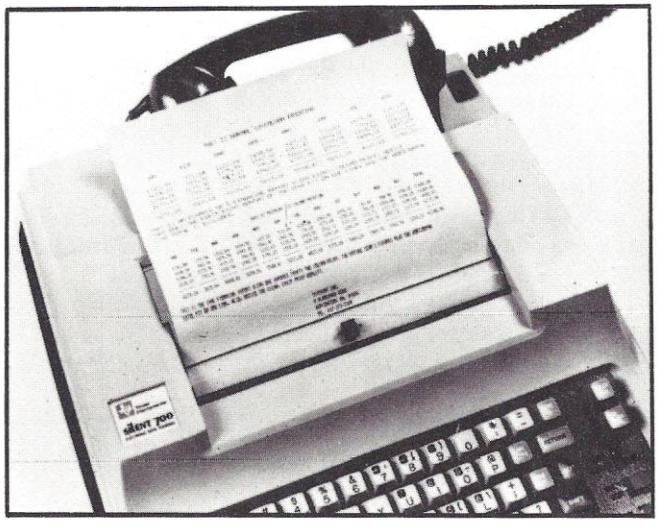
CIRCLE 26

continued from page 19



readability in a portable terminal, the company said.

The Texprint 132 may be installed in TI terminals with limited ASCII keyboard (upper case), with or without answerback memory option. Texprint 132 variants are also available for terminals with full ASCII keyboard, APL keyboard and solenoid line feed.

Texprint 132 is available for $375. Delivery is 30 days ARO. For more information, contact: Texprint, Inc., 8 Blanchard Rd., Burlington, MA 01803; (617) 273-3384.

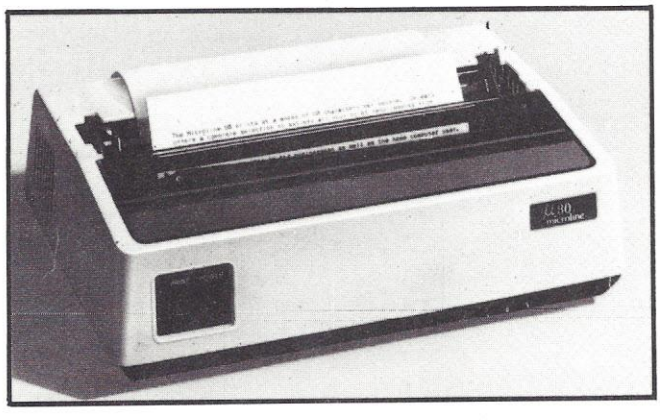
Circle No. 104.

Microline Printer Prices Reduced

Okidata Corporation has rolled back prices on its Microline 80 serial matrix printer by 25%. The company also reduced prices of the Microline 82 model. Both units operate at 80 characters-per-second. The 82 uses short line seeking logic to increase throughput and includes some forms controls not found on the 80.

Okidata cut the suggested retail price of the Microline 80 from $800 to $600. The suggested retail price of the Microline 82 was cut from $960 to $799.

The Microline head is warranted for 2,000,000,000



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CIRCLE 27

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DEC LA34AA	939	DEC LA34DA	1149
Teletype Model 43 KSR with RS232C and connector cable	1049	NEC Spinwriter 5520 Typewriter quality with Tractor, ribbon, thimble	3088

Printers

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Microline 80	594		
Centronics 737	828	Centronics 779	1068

call for other Centronics models

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CIRCLE 28

characters. Built on a rugged cast aluminum base, Microline printers include two motors to withstand the rigors of continuous use, the company said. The 80 and 82 printers accommodate friction, pin and tractor feed forms and are designed to provide short tear-off capabilities. Both units accept single sheets of plain paper and multipart forms.

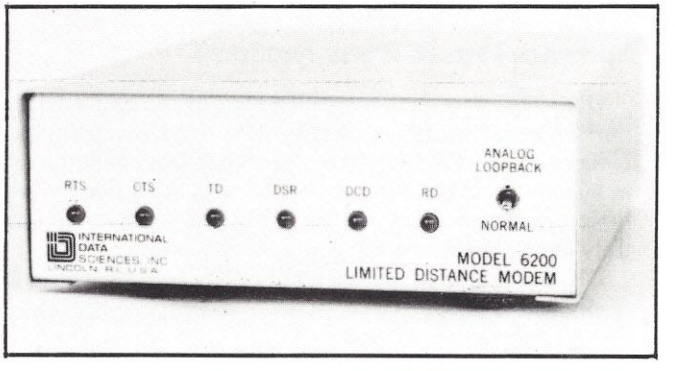
The printers also produce block graphics in addition to the full upper and lower case 96 character ASCII set. Users can generate charts, graphs and illustrations and explain them with captions of double width characters. The block shapes may also be used to create special character sets.

Microline printers are offered with RS-232 serial and Centronics-compatible parallel interfaces. The standard parallel interface operates with the TRS-80, Apple and other microcomputers.

Additional information may be obtained from: Okidata Corporation, 111 Gaither Dr., Mount Laurel, NJ 08054; (609) 235-2600. *Circle No. 105.*

Asynchronous Limited Distance Modem

International Data Sciences, Inc. has introduced the Model 6200 Limited Distance Modem, designed for asynchrous operation over private 2- and 4-wire non-loaded metallic (twisted pair) conductors at speeds of up to 19,200 bps. It can be used in both point-to-point and multidrop network configurations, and is ideally suited for local data distribution up to nine miles.



Features of the modem provide: internal strap selections for receiver impedance, receiver equalizer, and choice of 2 or 4-wire operation. The modem employs a baseband modulation scheme that varies the voltages of the transmit signal on a balanced line, therefore requiring dc continuity. Its data terminal equipment interface meets EIA RS-232 and CCITT V. 24 specifications. A 20 mA TTY current loop interface is also available.

Diagnostic capability is provided by an Analog Loopback mode that allows for a quick verification of system performance and helps isolate equipment failures in the communications link. Six front panel LEDs monitor key EIA interface signals.

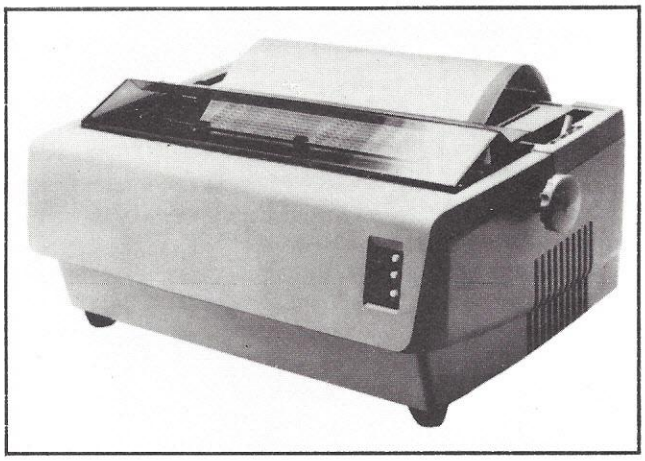
The IDS Model 6200 is priced at $225. For more informa-

tion contact Marketing Department, International Data Sciences, Inc., 7 Wellington Rd., Lincoln, RI 02865; (401) 333-6200. *Circle No. 106.*

Daisywheel Printer

Computer TEXTile, Inc., announced the availability of the Starwriter daisywheel printer. This letter-quality receive-only printer, manufactured by TEC, is priced at $1779.

The Starwriter prints at 25 characters-per-second and comes with an industry standard Centronics-compatible parallel interface. It uses Diablo ribbons and printwheels. It has full graphics capability (1/120-inch horizontal control, 1/48-inch vertical control) and is completely code-compatible with Qume and Diablo, so no software changes are required to use boldface, underlining and bi-directional printing.



The printer measures 24.6″ × 15″ × 10.2″ and weighs 44.1 pounds. It accommodates paper widths of up to 15-inches and will furnish three clear copies. Starwriter comes with a 90-day limited warranty.

For more information, contact Computer TEXTile, Inc., 10960 Wilshire Blvd., Los Angeles, CA; (213) 477-2196. *Circle No. 107.*

SOFTWARE

Software for the Legal Profession

MICROCON, INC., announced the release of LAW-1, a Time Management and Billing System for the legal profession. Written in CBASIC, and utilizing the CP/M operating system, the system is comprised of 38 integrated application programs (not including sorts and utilities). It is parameter-driven and can support floppy and/or hard-disk configurations with no programmer intervention. The direct cursor addressing functions will support varying types of terminals.

Designed to be "end-user" oriented, the major system features include: System and program security (passwords and access levels); complete Client/Matter and Attorney reporting (including attorney productivity reports); Accounts Receivable Ledgers and Aging Analysis: Pre-billing worksheets; Invoicing (on-account, interim, reimbursable costs, etc.); escrow, work-in-process, write-up/write-off and carryover analysis; automatic file back-ups and file utilization schematics; Billing and Payment Ledgers; and Mailing Labels. The system also includes an inquiry capability which permits the user to perform "other-than-standard" inquiries based upon specific selection criteria.

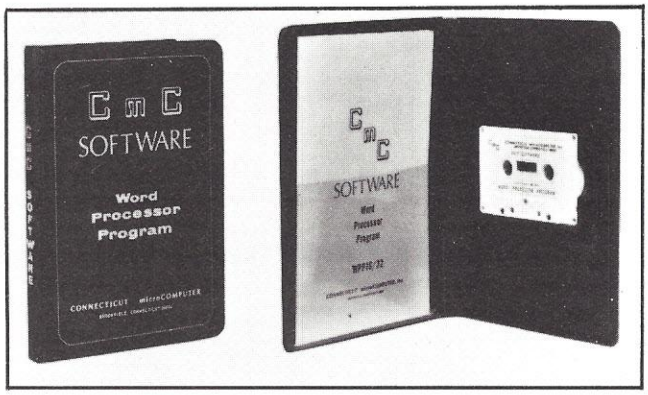
LAW-1 was designed by a team of CPAs, legal advisors and data processing consultants. Complete audit trails are included throughout the system. The package also includes a 250-page documentation manual.

A demo package is available for $75, and the entire package price is $800. For more information, contact: MICROCON, INC., P.O. Box 805, Amherst, NH 03031; (603) 673-0230. *Circle No. 108.*

Word Processing Program for Pet

The Word Processing Program (WPP) in 8K and 16/32K versions, is now used extensively for expanding the capabilities of Commodore Pet microcomputers, according to Connecticut microComputer, Inc.

WPP permits the composing and printing of letters, flyers, advertisements, manuscripts and other documents using the Pet and a printer. It incorporates print directives including:



line length, line spacing, left margin, centering and skip. Edit commands allow the operator to insert lines, delete lines, move lines and paragraphs, change strings, save files onto cassettes, load files from cassette, move up, move down, print, and type. The system can be modified for disk storage.

Added features for the 16/32K version include: string search for editing, keyboard entry during printing for letter salutations, justification, and multiple printing.

A 30-page instruction manual is included. The 8K version

continued on page 78

Hayden Performance Software -

from game room fun to boardroom business!

GAMES

SARGON II (Spracklen) The Champ of champs. "...an excellent program which will provide a true challenge for many players...Save your money and buy SARGON II..." ***'80 Software Critque. 03403, TRS-80 Level II; 03404, Apple II; 03410, OSI C1P; 03440, OSI C4P; each tape $29.95. 03408, TRS-80 Level II Disk; 03409, Apple II Disk; 03414, OSI C1P Disk; 03444, OSI C4P Disk; 03484, C8P Disk; each $34.95***

BLACKJACK MASTER: A Simulator/Tutor/Game (Wazaney) A serious game that performs complex simulations and evaluations of playing and betting strategies. ***05303, TRS-80 Level II tape, $24.95; 05308, TRS-80 Disk Version, $29.95***

MICROSAIL (Johnson) A true test of your nautical skills as you race against wind, tides, and time. ***04401, PET tape, $11.95***

GRIDIRON: A Microfootball Game (Microflair Associates) Be both offensive and defensive quarterbacks. Includes time-outs, penalties, and the two-point conversion option used in college football. ***03003, TRS-80 Level II tape, $12.95***

MAYDAY (Breitenbach) Out of fuel! Try to avoid crashing with this challenging airplane flight simulation. ***02601, PET tape, $9.95***

REVERSAL (Spracklen) Winner of the software division of the ***First International Man-Machine OTHELLO™ Tournament,*** this version of the 200-year old game Reversi, features 27 levels of play and high-resolution color graphics. ***07004, APPLE II tape, $29.95; 07009, APPLE II Disk, $34.95***

STARCLASH (Walton) An exciting game of galactic strategy for one or two players. ***05903, TRS-80 Level II tape, $16.95***

ROYAL FLUSH: Competitive Poker Solitaire (Wazaney) A game you can play alone or with any number of players. High score wins in this poker-based, fun-filled card game. Choose from possible game variations. ***07101, PET; 07103, TRS-80 Level II, each tape, $14.95***

BACKGAMMON (Wazaney) A classic game of skill and luck played against a preprogrammed opponent. ***02501, PET; 02503, TRS-80 Level II; each tape, $10.95***

BATTER UP!!: A Microbaseball Game (Savon) Action-packed baseball with 3 levels of play. ***02801, PET; 02803, TRS-80 Level II; each tape, $10.95***

BUSINESS

★★ **HISTO-GRAPH** (Boyd) A calendar-based histogram or bar-graph production system. Allows the user to enter numeric data that relates to a date, and reproduces that data as a high-resolution histogram. ***09009, Apple II Disk, $29.95***

FINPLAN: A Financial Planning Program for Small Businesses (Montgomery) Allows you to enter data from a balance sheet into the program, to make assumptions about the future growth of business, and to have the computer project results for up to a five year period based on those assumptions. And if you change any data, the program revises all resulting data automatically. The disk version can be used only with TRSDOS Version 2.3. ***05103, TRS-80 Level II tape, $69.95; 05108, TRS-80 Level II Disk Version, $74.95***

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☐ 01103	☐ 01404	☐ 02601	☐ 03304	☐ 03440	☐ 04501	☐ 05009	☐ 05509	☐ 07009	☐ 09109
☐ 01105	☐ 01407	☐ 02701	☐ 03401	☐ 03444	☐ 04503	☐ 05103	☐ 05601	☐ 07101	☐ 09409
☐ 01203	☐ 01413	☐ 02801	☐ 03403	☐ 03484	☐ 04504	☐ 05108	☐ 05603	☐ 07103	☐ 09704
☐ 01204	☐ 02401	☐ 02803	☐ 03404	☐ 03504	☐ 04513	☐ 05203	☐ 05609	☐ 07301	
☐ 01301	☐ 02403	☐ 02903	☐ 03408	☐ 03604	☐ 04609	☐ 05208	☐ 05613	☐ 07809	

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81-049 PC 4/81

Apple is a trademark of Apple Computer Company, Inc., and is not affiliated with Hayden Book Company, Inc.

Hayden software is available at computer stores everywhere!

DATA MANAGER: A Data Base Management System and Mailing List (Lutus) Store information on a floppy disk, and retrieve it quickly and easily by specific names, or by category. ***04909, Apple II Disk Version, $49.95.***

MAILING LIST (Tru-Data Software) Lists addresses, prints labels, allows for alterations and deletions, and has the capacity to make duplicate data file disks. Can only be used with version 1.5.
05713, Heath/Disk $49.95

UTILITY

LINE & VARIABLE CROSS REFERENCE GENERATOR (Johnson) Provides a cross-reference of line numbers and variable names.
07301, PET tape, $16.95

APPLESOFT UTILITY PROGRAMS (Gilder) Increase your BASIC programming speed and flexibility. Contains 9 useful subroutines: 1. REM Writer 2. PRINT Writer 3. POKE Writer 4. Hexadecimal/Decimal Converter 5. Line Counter 6. Renumber 7. Append 8. Byte Counter 9. Slow List/Stop List
03504, Apple II tape, $29.95

RENUMBER & APPEND: Utility Programs for the Apple (Gilder) Renumber your Applesoft program and append a second program to the one in memory.
03804, Apple II tape, $14.95

REVIVE (Gilder) When a program is accidentally erased, REVIVE searches through memory and finds the information that enables it to restore the pointers that have been changed. ***03604, Apple II tape, $19.95***

SLOW LIST/STOP LIST: Utility Programs for the Apple (Gilder) Start, stop, and control the speed of your program with Apple II's game paddles. ***03904, Apple II tape, $10.95***

PSEUDODISK (Neuschatz) This money-saving program simulates a disk memory system for Integer BASIC programs. It allows multiple programs in memory at the same time which can be run from a catalog. ***04804, APPLE II tape, $24.95***

6502 DISASSEMBLER (Stamm) Produce assembly language source files with labeled subroutines and references from programs already in memory. It is compatible with Hayden's ASSEMBLY LANGUAGE DEVELOPMENT SYSTEM.
08609, APPLE II Disk, $39.95

DISK CERTIFIER AND COPIER (Jacc Inc.) A handy utility program that certifies the acceptability of blank diskettes and rejects those with flaws. It also includes a fast machine language disk copying program that will work on single and dual drive systems. ***07809, APPLE II Disk, $19.95***

DISK CATALOGER (LeBar) Automatically maintains a cross-reference listing of all your programs, their location by disk number, their function and use. Catalogs, lists and sorts programs. ***05203, TRS-80 Level II tape, $16.95; 05208, TRS-80 Level II Disk, $21.95***

LANGUAGE

PROGRAMMING IN APPLE™ INTEGER BASIC: Self-Teaching Software (Banks & Coan) Teach yourself Apple Integer BASIC and control your own progress at all times with this interactive programmed instruction format. ***05004, Apple II, tape, $29.95; 05009, Apple II Disk Version, $39.95***

APPLE™ ASSEMBLY LANGUAGE DEVELOPMENT SYSTEM: An Assembler/Editor/Formatter (Lutus) Write and modify your machine language programs quickly and easily. ***04609, Apple II Disk Version, $39.95.***

SUPER APPLE™ BASIC (Lutus) A structured BASIC that compiles into an optimized Applesoft or Integer BASIC program. ***05409, Apple II Disk, $39.95*** •

Super FORTH (Bugbee) This is a fast, high-level, expandable language that features integer and floating-point math, high-resolution graphics and string handling capability. ***05509, APPLE II Disk, $49.95***

ENGINEERING

★★ **OP-AMP DESIGN** (Gabrielson) Provides the necessary values for your design and will suggest appropriate op-amp types. Includes a choice of six op-amps, and the program will then determine if your selection of an op-amp will be acceptable within your chosen parameters. Can be updated to accommodate future op-amps. ***09704, Apple II tape, $16.95***

★★ **DOUBLE PRECISION FLOATING POINT FOR APPLESOFT™** (S-C Software) Extends the accuracy of the arithmetic available on the Apple from nine digits to a full 21-digit precision on all functions in Applesoft compatible format. ***09409, Apple II Disk, $49.95***

MCAP: A Microcomputer Circuit Analysis Program (Savon) Performs a linear voltage, impedance, or transfer impedance analysis of an electronic circuit. ***04501, PET; 04503, TRS-80 Level II; 04504, Apple II; each tape $24.95; 04513, Heathkit/Zenith Disk, $29.95***

ENGINEERING MATHEMATICS-1 (Gilder) Contains eight programs useful to the engineer: 1. Solving Simultaneous Equations 2. Evaluation of a Polynomial 3. Quadratic Equations 4. Integration by Simpson's Rule 5. Newton-Raphson Roots 6. Derivative of a Function 7. Factorial of a Given Number 8. Extended Factorial Calculation. ***01301, PET; 01303, TRS-80 Level II; 01304, Apple II; each tape $14.95***

MICROCOMPUTER AIDED DESIGN OF ACTIVE FILTERS (Gilder) Eight programs that simplify the design of active filters and will calculate the component values needed for various bandpass, low-pass, and notch-type filters. ***01401, PET; 01403, TRS-80 Level II; 01404, Apple II; 01407, Heath; each tape $16.95; 01413, Heathkit/Zenith Disk Version, $21.95***

EDUCATION

CROSSBOW (Breitenbach) Features a target game that, besides offering hours of fun, teaches fractions in an exciting and competitive environment. An educational program for all ages. ***02701, PET tape. $9.95***

GENERAL MATHEMATICS-1 (Gilder) Contains 15 programs useful to anyone who wants to improve their math skills and accelerate their computation. The fifteen programs are: 1. Log to Any Base 2. New Coordinates 3. Rectangular/Polar Coordinates 4.Permutations 5. Combinations 6. Vector Cross-Products 7.Vector Scalar Products 8. Max/Min Locator 9. Number Rounder 10. Dimension Scaler 11. Histogram 12.Circle Finder 13. Nth Root of a Number 14. Nomally Distributed Random Numbers 15.Rational Fractions. ***01101, PET; 01103, TRS-80 Level II; 01104, Apple II; 01105, Sorcerer; each tape $14.95***

COMPLEX MATHEMATICS (Gilder) Contains 8 programs that give the user the ability to perform computations of complex numbers in BASIC rather than in FORTRAN. The eight programs are: 1.Absolute Value 2.Complex Subtraction 4. Complex Multiplication 5. Complex Division 6. Nth Roots of a Complex Number 7. Complex Exponential 8. Complex Number to a Real Power. ***01201, PET; 01203, TRS-80 Level II; 01204, Apple II; each tape $14.95***

AT HOME

ENERGY MISER (SuperSoft Associates) A complete heating/cooling analysis program for your home or office that will calculate heat loss or gain due to poor insulation, leaky doors and windows, and more. ***05601 PET; 05603, TRS-80 Level II; each tape $29.95; 05609, Apple II Disk Version; 05613, Heathkit/Zenith Disk Version; $29.95***

PERSONAL PROPERTY INVENTORY (Southern Systems) Here's an easy-to-use program that lets you develop, maintain, sort and save an inventory of your personal property.
08903, TRS-80 Level II tape, $14.95

GENERAL INTEREST

★★ **DATA-GRAPH** (Boyd) Aids in the preparation of graphs and charts. Numeric data can be entered into Data-Graph and used to create colorful one-, two-, or four-quadrant graphs. ***09109, Apple II Disk, $49.95***

SONGS IN THE KEY OF APPLE (Lopatin) Allows you to see and hear your favorite tunes, pre-programmed tunes or music you create (up to 200 notes, including rests, per musical piece).
03304, Apple II/tape, $10.95

SKETCHMODE (Walton) Create computer graphics, modify them, save them, and read them from tape.
03203, TRS-80 Level II tape, $11.95

KEYNOTE (Microflair Associates) Hear any type of music in slow, medium, or fast tempo. ***02903, TRS-80 Level II tape, $9.95***

BIOCURVE (Microflair Associates) Charts your biorhythms against another person's and suggests when you will be in a state of instability and therefore vulnerability. ***03103, TRS-80 Level II tape, $9.95***

THE FIRST BOOK OF KIM, 3 Tapes (Butterfield, Ockers, and Rehnke) Three cassettes featuring 28 recreational and 13 utility and diagnostic programs, ***00700, KIM-1*** (14 recreational programs); ***00800, KIM-1*** (14 recreational programs); ***00900, KIM-1*** (13 utility programs); ***each tape $9.95***

MICROTYPING (Engel) Features the "touch method" of learning to type for improving your computer skills. ***02401, PET; 02403, TRS-80 Level II; 02404, Apple II; each tape $10.95***

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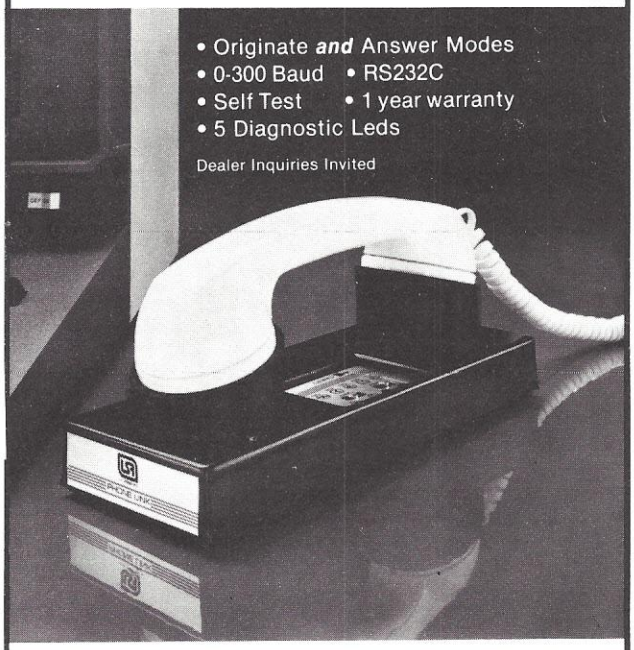

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CIRCLE 31

WHAT'S COMING UP

continued from page 75

lists for $29.95; the 16/32K version is priced at $39.95. For more information, contact: Connecticut microComputer, Inc., 34 Del Mar Dr., Brookfield, CT 06804. *Circle No. 109.*

Applesoft Version of Typing Tutor

Microsoft Consumer Products has released an Applesoft version of its Typing Tutor program, the software package that both teaches typing and helps build typing speed through individualized lessons and drills.

The Applesoft version, which comes on disk, operates identically to the Integer BASIC version of the program, according to Microsoft.

Typing Tutor uses short exercises and longer paragraph drills to teach keys and drill on problem areas. It advances at the user's pace, not proceeding to more difficult levels until proficiency is shown at current levels. Immediate feedback on speed, weak keys and percent accuracy is provided after each paragraph drill through TRM (Time Response Monitoring) software that monitors the keyboard 20 times per second.

The Applesoft version requires an Apple II or Apple II Plus, Applesoft, 32K RAM and one disk drive. Retail price is $19.95. The package includes diskette and instruction manual.

Microsoft Typing Tutor is sold through Microsoft retail dealers. For more information, contact: Microsoft Consumer Products, 400 108th Ave. NE, Suite 200, Bellevue, WA 98004; (206) 454-1315. *Circle No. 110.*

Data Base System for CP/M

An information retrieval program from Island Cybernetics, called Information Master, is designed to handle a large body of static information where flexible access is required. This is accomplished by creating a compact index to the text files based on key words or phrases designated by the user.

The text files containing the data to be retrieved may be created with any CP/M-compatible text editor or user program in a free-form format. The main program maintains a dictionary of all key words indexed, and rapidly searches the index on Boolean (and/or) combinations of key words. Retrieved data can be displayed, printed or written to another file.

Only the index and dictionary files need to be on the same disk with the program. The files containing the information may be on one or many other disks. When searching for data, the program directs the user to the disk that contains the data file to use, and handles the CP/M requirements for mounting the disks.

A unique feature of the system is the "close to" feature.

continued on page 80

Calendar

March 30-April 2—INTERFACE '81; Las Vegas Convention Center; The Interface Group, 160 Speen St., Framingham, MA 01701; (617) 879-4502.

April 6-10—TUTORIAL WEEK EAST '81; Orlando Marriott Inn, Orlando, FL; IEEE Computer Society; 10662 Los Vaqueros Circle, Los Alamitos, CA 90720.

April 7-9—COMPUTERIZED OFFICE EQUIPMENT EXPO MIDWEST; O'Hare Exposition Center, Chicago, IL; Cahner's Exposition Group, 222 West Adams St., Chicago, IL 60606; (312) 263-4866.

April 9-12—THE SOUTHWEST COMPUTER SHOW; The Dallas Market Hall, Dallas, TX; The National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167; (617) 739-2000.

April 14-16—FEDERAL DP EXPO; Sheraton Washington Hotel, Washington, DC; The Interface Group, 160 Speen St., Framingham, MA 01701; (617) 879-4502.

April 25-26—TRENTON COMPUTER FESTIVAL; Trenton State College, Trenton, NJ; Trenton State College, Hillwood Lakes, P.O. Box 940, Trenton, NJ 08625; (609) 771-2487.

May 16—SHOW AND TELL MICROCOMPUTER CONFERENCE; University of Oklahoma Physical Science Center, Norman, OK; Richard Andree, O.U. Math Dept., 601 Elm St., Norman, OK 73019.

May 29-31—COMPUTERFEST '81; Franklin University, Columbus, OH; Terry Williams, 1850 Brookview Circle, Bloomfield Hills, MI 48013.

RANDOM ACCESS

(continued from page 15)

Artificial Intelligence

Artificial Intelligence will be examined in a week-long conference to be held at the University of British Columbia in Vancouver, Canada, August 24–28.

Conference topics will include medical diagnosis by computer, person/machine interaction, computer-aided design, memory models, knowledge representation, speech understanding, psychological modeling, three-dimensional representation and processing.

For more information, contact: Louis G. Robinson, American Association for Artificial Intelligence, Stanford University, Box 3036, Stanford, CA 94305; (415) 495-8825.

(continued on page 93)

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CIRCLE 32

TRS-80 OWNERS
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Introducing SIMUTEK'S ZBASIC. The truly interactive BASIC COMPILER for your TRS-80! FINALLY! People that don't have the time or the inclination to learn complicated assembly language, have a chance to write PROFESSIONAL QUALITY SOFTWARE in machine language using a subset of LEVEL II BASIC!!

What does interactive mean? It means you have ZBASIC and your BASIC program resident at the same time! You may compile a BASIC program, run it or save it without destroying your resident BASIC program! In fact, jumping back and forth between the compiled code and the BASIC code is one of its finest features!

ZBASIC allows saving your COMPILED PROGRAM as a system tape, (tape version), or as /CMD file, (disk version). THE COMPILED CODE IS VERY EFFICIENT Z80 OBJECT CODE. THE LEVEL II ROMS ARE USED ONLY FOR I/O ROUTINES!!

FACTS ABOUT ZBASIC

1. 16K ZBASIC will compile a 4.8K program. (tape only)
   32K ZBASIC will compile a 17K (tape), 10K (disk) pgm.
   48K ZBASIC will compile a 17K program. (disk only)
   (These are approximate values depending on program efficiency etc.)
2. ZBASIC DOES NOT support disk or tape files.
3. BASIC programs compiled with ZBASIC are between 10-200 times faster than interpreted BASIC!!
4. NO ROYALTIES ON ZBASIC COMPILED PROGRAMS!!
5. ZBASIC programs are only about 1.1 times larger than the average basic program.
6. ZBASIC programs may be used as USR routines from basic.
7. ZBASIC uses INTEGER MATH ONLY to increase speed and decrease compiled program size. Use of Single or Double precision would destroy the beauty of the first "INTERACTIVE COMPILER" on the market!
8. Limited variables: A-Z, A1-Z1, A2-Z2, A$-Z$. Arrays are not supported to decrease memory demands and speed up compiling of programs.
9. COMPILE TIMES ARE TYPICALLY 1 TO 10 SECONDS! THERE IS NO NEED TO USE COMPLICATED COMPILE TIME MODULES!
10. ZBASIC comes with a HIGHLY DETAILED manual describing all important memory locations, commands, variables, warm/cold start entry points and many useful sub-routines for emulating unsupported commands!!
11. Existing programs may be loaded from tape or disk and compiled as long as unsupported commands or variables are not used.

ALL COMMANDS DIRECTLY SUPPORTED BY ZBASIC

FOR	NEXT	STEP	IF	THEN	ELSE	PEEK
SET	RESET	POINT	CHR$	RANDOM	RND	POKE
DATA	READ	RESTORE	END	GOTO	GOSUB	CLS
INPUT	INKEY$	LET	STOP	OUT	INP	RETURN
PRINT	LPRINT	PRINT@	USR	SGN	INT	ABS
SQR	LEN	ASC	VAL	STR$	POS	ON GOTO
ON GOSUB	REM	NOT	AND	OR		

INTEGER MATH: *MULTIPLY /DIVIDE +ADD −SUBTRACT + '− 32767

NOTE: Some commands do not act exactly as BASIC commands act

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CIRCLE 33

continued from page 78

An invalid key word entry, when retrieving data, will cause the program to display a group of key words which are in the dictionary and are alphabetically close to the invalid entry. This allows you to guess your way to the information desired.

The system is ideal for handling abstracts from scientific literature, product literature, record and book collections, correspondence, recipes, minutes of meetings and applications where data is not frequently modified but a large base is required, the company said.

Fifteen hundred keywords, averaging ten characters each, can be handled with 48K of memory. The index file is so compact that more than 6000 entries, averaging ten keywords each, can be indexed on a single 8-inch disk, the company said.

The interactive program is easy to operate, according to Island Cybernetics, with the user selecting options from different prompting menus. A user manual and a demonstration data base are included with each system.

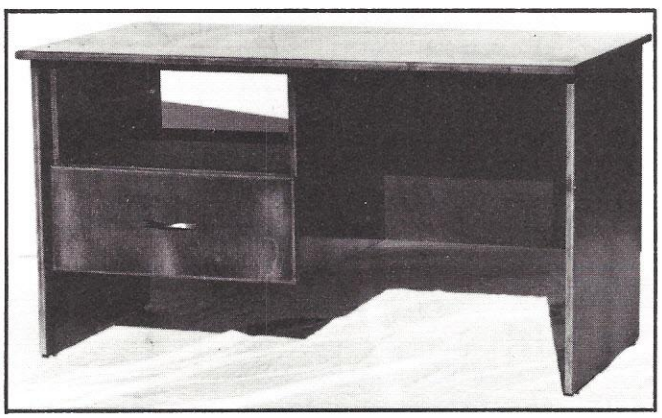
The Information Master system is furnished on a CP/M-compatible single-density 8-inch disk. It is also available on a 5-inch hard-sectored version for Heath H-8 and H-89 modified CP/M, as well as on 5-inch quad-density disks for Vector Graphic CP/M. Both the 8-inch and 5-inch disks are $37.50 plus $1.50 for shipping and handling. For more information, contact: Elliam Associates, 24000 Bessemer St., Woodland Hills, CA 91367. *Circle No. 111.*

ACCESSORIES

Furniture For Computers and Printers

These new desks and printer stands are made of real hardwood with an oak finish (which can be varied to suit individual customer needs). The desk is standard typewriter height with either left or right hand knee-hole. The desk comes with one drawer (the upper space being reserved for a table-top computer), but another drawer can be added if necessary. Both drawers can be removed for computer expansion. The computer/drawer module can be varied in size by special order.

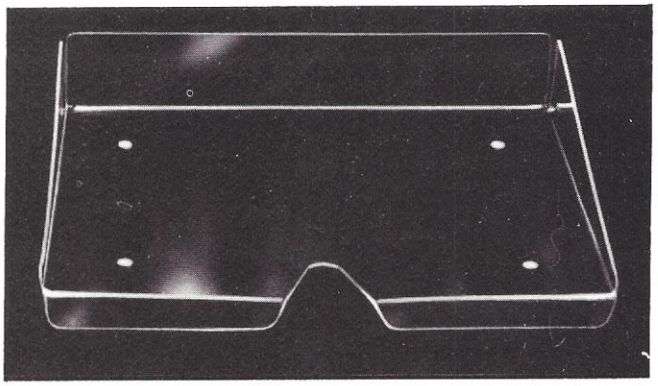
The printer stand is designed to permit the computer operator to observe the printing function clearly from a



seated position. It comes mounted on casters for ease of mobility. A pull-out paper catcher is included with the stand, which will accommodate both bottom-feed and back-feed printers.

This furniture is marketed only through computer dealers, and carries a 30 to 45-day delivery wait.

For more information, contact: Abacus Cabinet Systems, 543-B West Betteravia Road, Santa Maria, CA 93455; (805) 928-4551. *Circle No. 112.*



CRT Tray Adds to Work Station Efficiency

People who operate cathode ray tube terminals face an awkward situation. The average CRT unit sits on a desk or a table that is no more than five or six inches wider than the terminal itself, so there is very little room for printouts or other papers.

Perk Company of Palo Alto, CA, a manufacturer of office and desk accessories, has devised a simple and attractive solution to this problem. Perk produced a special tray fabricated of clear PLEXIGLAS® brand acrylic plastic sheet that sits securely on the top of a CRT console. The tray, which measures 16-inches across, 12-inches deep and 2½-inches high, easily accommodates 14⅞-inch-wide DP printouts and other work papers.

A formed lip in the front of the tray fits over the edge of the console to hold the tray in place, and the unit rests on four corner cushions of a slip-resistant foam. An open front and handy thumb notch provide easy access to the contents of the tray.

Perk Company employs PLEXIGLAS acrylic sheet for this application because of its thermoformability, durability, light weight and clarity.

James E. Giulie, president of Perk Company, reports that he custom-designed the first of the Perk cathode ray tube trays for a business associate who asked: "What can we do to clean up the mess around my computer terminals?" The

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40 PIN	.40	.38

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CIRCLE 25

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FINE PRINT

*TRS-80 is a Tandy Corporation trademark. Use of above operating systems may require the use of Radio Shack TRS-DOS. Radio Shack equipment subject to the will and whim of Radio Shack.

ORDERING INFORMATION

We accept Visa and Mastercharge. We will ship C.O.D. certified check or money orders only. Massachusetts residents add 5 percent sales tax.

The company cannot be liable for pictorial or typographical inaccuracies.

CIRCLE 21

special tray of clear PLEXIGLAS sheet proved to be a very effective answer. Since then, the product has enjoyed widespread success.

"Currently it is one of our best-selling items," Mr. Giulie said. "It appears now that no CRT work station is complete without a Perk tray."

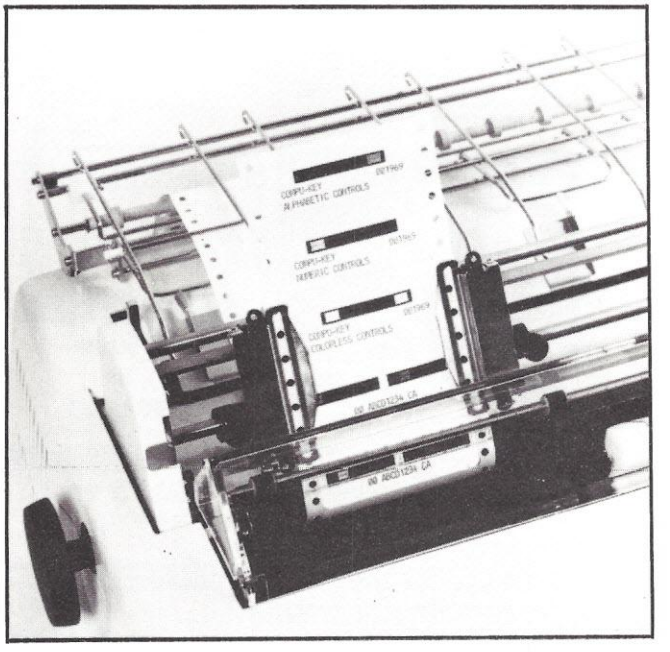
PLEXIGLAS acrylic sheet is a combustible thermoplastic material and must be used in accordance with controlling building code requirements. The same fire precautions observed in connection with the handling and use of any ordinary combustible material should be observed when handling, storing or using PLEXIGLAS.

For more information on the PERK tray, contact: the PERK Company, 1015 Corporation Way, Palo Alto, CA 94303; (415) 964-1807. *Circle No. 113.*

Computer-Generated Color-coded Labels

Businesses can now use their desktop computers or word processors to utilize a new, efficient filing system being introduced by Wenner Business Systems.

The computer-generated color coding system, called Compu-Key, can produce random-number or custom, alpha color-coded labels, which will eliminate misfiling in any filing system. The labels can be applied to any size or style folder.



Compu-Key is available with either of two options: as a complete turnkey system with a desktop computer and printer, or as ready-to-run software for use by companies with existing hardware.

Compu-Key can also create machine-readable bar codes, special alpha or numeric prefixes, and even a percentage graph for non-color file control. The color codes and other file controls are printed on special patented labels that fit any

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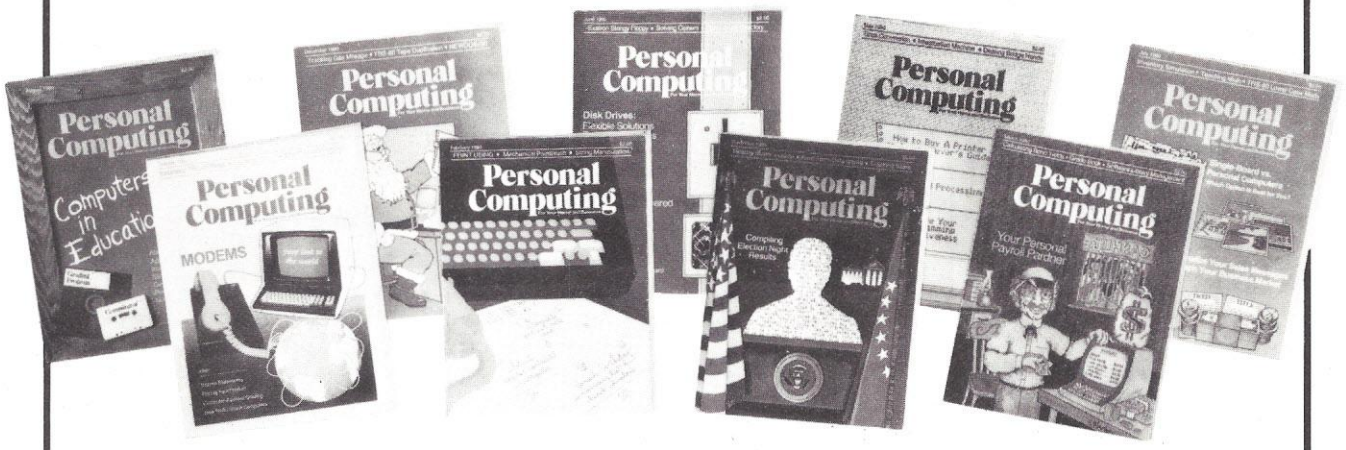
RUN

If finding a copy of PERSONAL COMPUTING every month has you on the run . . . here's a better way!



Hell hath no fury like a microcomputerist who has to scamper around town looking for the newest issue of *Personal Computing* magazine.

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CIRCLE 37

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standard printer. Software can be supplied to run on any type of computer or word-processor system.

According to Wenner Business Systems, Compu-Key adds a new dimension to records management. The system can also supply automatic purge dates, cross-reference, or location of other files. Optional bar code software and reader are also available for charge-out control.

For more information, contact: Wenner Business Systems, P.O. Box 831, 170 State St., Los Altos, California, 94022. *Circle No. 114.*

LITERATURE

New Telecommunications Journal

Cross Communications Company has announced that it will begin publishing, electronically, a new journal for the professional involved with information systems technologies. The new journal, named ISYS, will provide a monthly focus on knowledge of the highly-diverse and rapidly-changing information technologies and their markets.

Leading professionals will contribute their personal opinions, developments, experiences and research on the critical issues facing business and management in the information industry. ISYS will be the first electronically-published, professional journal for today's information system professionals, the company claims.

ISYS is under the direction of Mr. R. Craig Blackman, former publisher of *Telecommunications Magazine* and who is currently President of Spencer/Blackman of Dallas, Texas. The editorial advisors for the ISYS journal include: Dale G. Mullen, Manager of Telecommunication for Johns-Manville, Denver, CO; Paul Daubitz, President of Associated Telemanagement, Boston, MA; and Dr. John F. O'Neill, President of ONECOM, Inc., Boulder, CO.

For more information on ISYS, contact: Daniel C. Thomann, Director of Marketing, Cross Communications Company, 934 Pearl Street, Suite B, Boulder, CO 80302. *Circle No. 115.*

"Prompt" Labeling System Brochure

PROMPT, a programming system for designing and producing customized labels automatically, is described and illustrated in a four-page, four-color brochure from The Standard Register Company.

The brochure lists the advantages of using a compact, flexible system for producing shipping labels, bills of lading, product ID, name tags, mailing lists, stock labels and retail shelf labels. PROMPT provides a fast, easy-to-use, and cost-efficient method of form layout and label printing from

continued on page 94

Simulation: How Can It Help?

```
100 DEFINT B-R,T-X:RANDOM:DIM SS(16)
105 DIM AD(6,200),AL(10),AU(10),BN(10),BP(10)
110 FOR I=1 TO 16:SS(I)=0.0:NEXT I:CLS
120 PRINT "** DR. EVANS' SCHEDULING SIMULATION **":PRINT
130 INPUT "DO YOU WISH OPERATING INSTRUCTIONS (Y/N)";Z$
140 IF Z$<>"Y" GOTO 290
150 CLS
160 PRINT "  THIS PROGRAM SIMULATES THE OPERATION OF A CLINIC."
170 PRINT "RANDOM OR APPOINTMENT ARRIVALS ARE ACCOMODATED.  IF"
180 PRINT "ARRIVALS ARE RANDOM, CUMULATIVE DISTRIBUTION IN"
190 PRINT "PERCENT MUST BE INPUT.  CUMULATIVE SERVICE TIME"
200 PRINT "DISTRIBUTION MUST BE INPUT.  LENGTH OF DAY MUST BE"
210 PRINT "SUCH THAT NUMBER OF PATIENTS WILL NOT EXCEED 50."
220 PRINT "NO MORE THAN 200 ITERATIONS CAN BE MADE.  EMERGENCY"
230 PRINT "PATIENTS HAVE SERVICE TIMES OF 30 OR 60 MINUTES."
240 PRINT:INPUT "PRESS ENTER WHEN READY TO BEGIN";Z$
290 CLS:INPUT "ENTER APPOINTMENT INTERVAL (0=RANDOM)";PT
295 IF PT>0 GOTO 360
300 INPUT "ENTER # OF POINTS IN ARRIVAL TIME DISTRIBUTION";NA
310 DIM AT(NA),PA(NA)
320 FOR J=1 TO NA
330 PRINT "FOR POINT #";J;
340 INPUT " ENTER TIME AND CUMULATIVE PERCENTAGE";AT(J),PA(J)
350 NEXT J:CLS
360 INPUT "ENTER # OF POINTS IN SERVICE TIME DISTRIBUTION";NS
370 DIM ST(NS),PS(NS)
380 FOR J=1 TO NS
390 PRINT "FOR POINT #";J;
400 INPUT " ENTER TIME AND CUMULATIVE PERCENTAGE";ST(J),PS(J)
410 NEXT J:CLS
420 INPUT "ENTER LENGTH OF EACH DAY IN MINUTES";TX:PRINT
430 INPUT "ENTER NUMBER OF ITERATIONS";NI
435 INPUT "ENTER PRINT CONTROL (1=DETAILED;0=SUMMARY)";IP
440 DIM C(50),A(50),TA(50)
445 DIM S(50),TS(50),TF(50),L(50),ID(50),WT(50)
450 FOR II=1 TO NI
455 REM ** SIMULATION LOOP **
460 MI=0:ML=0:MW=0:TA(0)=-PT:I=0
504 IF PT=0 GOTO 510
506 GOSUB 2000:GOTO 660
508 REM ** GENERATE ARRIVALS AND PRIORITIES **
510 I=I+1
520 C(I)=1
530 J=RND(100)
540 IF J=98 THEN C(I)=3
550 IF J>98 THEN C(I)=2
560 J=RND(100)
570 FOR K=1 TO NA
580 IF J>PA(K) GOTO 610
590 A(I)=AT(K)
600 GOTO 630
610 NEXT K
620 PRINT "ARRIVAL PERCENTAGE > 100":STOP
625 REM ** COMPUTE TIME OF ARRIVAL **
630 TA(I)=TA(I-1)+A(I)
640 IF TA(I)<TX GOTO 510
650 NP=I-1
660 M=0
670 M=M+1
680 WT(M)=0:ID(M)=0
685 REM ** GENERATE SERVICE TIMES **
690 ON C(M) GOTO 700,770,780
700 J=RND(100)
710 FOR K=1 TO NS
720 IF J>PS(K) GOTO 750
730 S(M)=ST(K)
740 K=NS
750 NEXT K
760 GOTO 790
770 S(M)=30.:GOTO 790
780 S(M)=60.
790 IF M<NP GOTO 670
795 REM ** TIME COMPUTATIONS FOR FIRST PATIENT **
800 TS(1)=TA(1):TF(0)=0
810 TF(1)=TS(1)+S(1)
820 L(1)=0:ID(1)=TA(1)
830 IF ID(1)>MI THEN MI=ID(1)
835 REM ** TIME COMPUTATIONS FOR OTHER PATIENTS **
840 FOR I=2 TO NP
850 IF TA(I)<TF(I-1) GOTO 920
855 REM ** NO WAIT PATH **
860 TS(I)=TA(I)
870 TF(I)=TS(I)+S(I)
880 L(I)=0
890 ID(I)=TA(I)-TF(I-1)
900 IF ID(I)>MI THEN MI=ID(I)
910 GOTO 1320
915 REM ** WAIT PATH **
920 FOR K=1 TO I
930 IF TA(I)>TF(I-K) GOTO 960
940 NEXT K
950 PRINT "ERROR!  NUMBER WAITING>NUMBER PATIENTS.":STOP
960 KK=K-2
970 IF KK>ML THEN ML=KK
980 L(I)=KK
985 IF KK=0 GOTO 1290
990 IF C(I)=1 GOTO 1290
995 REM ** ADJUST ARRAYS FOR EMERGENCY PATIENT **
1000 IK=I-KK
1010 T1=TA(IK)
1020 T2=S(IK)
1030 L1=L(IK)
1040 T3=WT(IK)
1045 C1=C(IK)
1050 TA(IK)=TA(I)
1060 S(IK)=S(I)
1070 L(IK)=L(I)
1075 C(IK)=C(I)
1080 TF(IK)=TS(IK)+S(I)
1090 WT(IK)=TF(I-K+1)-TA(I)
1100 LU=K-3
1110 IF LU<0 GOTO 1210
1120 FOR J=0 TO LU
1130 IJ=I-J
1140 TA(IJ)=TA(IJ-1)
1150 S(IJ)=S(IJ-1)
1160 TS(IJ)=TS(IJ-1)+S(IK)
1170 TF(IJ)=TF(IJ-1)+S(IK)
1180 L(IJ)=L(IJ-1)
1190 WT(IJ)=WT(IJ-1)+S(IK)
1195 C(IJ)=C(IJ-1)
1200 NEXT J
1210 IM=IK+1
1220 S(IM)=T2
1230 TA(IM)=T1
1240 L(IM)=L1
1245 C(IM)=C1
1250 WT(IM)=T3+S(IK)
1260 TS(IM)=TF(IK)
1270 TF(IM)=TF(IK)+T2
1280 GOTO 1320
1290 TS(I)=TF(I-1)
1300 TF(I)=TS(I)+S(I)
1310 WT(I)=TS(I)-TA(I)
1320 NEXT I
1330 FOR I=1 TO NP
1340 IF WT(I)>MW THEN MW=WT(I)
1350 NEXT I
1355 CLS:PRINT "** ITERATION #";II;"**"
1360 IF IP=0 GOTO 1430
1362 REM ** DETAILED PRINTOUT **
1365 LL=1:IF NP>10 THEN UL=10 ELSE UL=NP
1370 PRINT " PAT        ARR   BGN   SRV   END   WAIT IDLE LINE"
1380 PRINT "  #    CLS    T     T     T     T     T    T   LNG"
1390 AA$=" ###    #    ###   ###   ###   ###   ###  ###   ##"
1400 FOR I=LL TO UL
1410 PRINT USING AA$;I,C(I),TA(I),TS(I),S(I),
TF(I),WT(I),ID(I),L(I)
1420 NEXT I:PRINT:IF UL=NP GOTO 1430
1422 INPUT "MORE DATA, PRESS ENTER WHEN READY";Z$
1424 LL=UL+1:UL=UL+10:IF UL>NP THEN UL=NP
1426 GOTO 1370
1430 INPUT "PRESS ENTER WHEN REVIEW COMPLETE";
Z$:S1=0.:S2=0.:S3=0.
1435 REM ** COMPUTE ITERATION SUMMARIES **
1440 FOR I=1 TO NP
1450 S1=S1+ID(I)
1460 S2=S2+WT(I)
1470 S3=S3+L(I)
1480 NEXT I
1490 AI=S1/TF(NP)*100.
1500 AW=S2/NP
1510 AL=S3/NP
1515 REM ** MAKE SUMMARY PRINTOUT **
1520 PRINT "FRACTION OF TIME IDLE WAS";AI;" PERCENT."
1530 PRINT "AVERAGE WAITING TIME WAS";AW;" MINUTES."
```

(*continued*)

Simulation (continued)

```
1540 PRINT "AVERAGE NUMBER WAITING WAS";AL;"."
1550 PRINT "MAXIMUM IDLE TIME WAS";MI;" MINUTES."
1560 PRINT "MAXIMUM WAIT WAS";MW;" MINUTES."
1570 PRINT "MAXIMUM LINE LENGTH WAS";ML;"."
1575 IF IP>0 INPUT "PRESS ENTER TO CONTINUE";Z$
1578 REM ## COLLECT STATISTICS ##
1580 SS(1)=SS(1)+AI:SS(2)=SS(2)+AI*AI
1585 AD(4,II)=AI
1590 SS(3)=SS(3)+AW:SS(4)=SS(4)+AW*AW
1595 AD(5,II)=AW
1600 SS(5)=SS(5)+AL:SS(6)=SS(6)+AL*AL
1605 AD(6,II)=AL
1610 SS(7)=SS(7)+MI:SS(8)=SS(8)+MI*MI
1615 AD(1,II)=MI
1620 SS(9)=SS(9)+MW:SS(10)=SS(10)+MW*MW
1625 AD(2,II)=MW
1630 SS(11)=SS(11)+ML:SS(12)=SS(12)+ML*ML
1635 AD(3,II)=ML
1640 SS(13)=SS(13)+NP:SS(14)=SS(14)+NP*NP
1650 SS(15)=SS(15)+TF(NP):SS(16)=SS(16)+TF(NP)*TF(NP)
1660 NEXT II
1665 REM ## COMPUTE MEANS AND STANDARD DEVIATIONS ##
1670 SZ=SS(7)/NI
1680 SY=SQR(SS(8)/NI-SZ*SZ)
1690 SX=SS(9)/NI
1700 SW=SQR(SS(10)/NI-SX*SX)
1710 SV=SS(11)/NI
1720 SU=SQR(SS(12)/NI-SV*SV)
1730 SS=SS(1)/NI
1740 SR=SQR(SS(2)/NI-SS*SS)
1750 SQ=SS(3)/NI
1760 SP=SQR(SS(4)/NI-SQ*SQ)
1770 SO=SS(5)/NI
1780 SN=SQR(SS(6)/NI-SO*SO)
1790 SL=SS(13)/NI
1800 SM=SQR(SS(14)/NI-SL*SL)
1810 SJ=SS(15)/NI
1820 SK=SQR(SS(16)/NI-SJ*SJ)
1825 REM ## PRINT STATISTICAL PARAMETERS ##
1830 CLS:PRINT "          MEAN    STD DEV"
1840 AB$=" ###.#    ###.#"
1850 PRINT "MX IDLE";USING AB$;SZ,SY
1860 PRINT "MX WAIT";USING AB$;SX,SW
1870 PRINT "MX LINE";USING AB$;SV SU
1880 PRINT "AV IDLE";USING AB$;SS,SR
1890 PRINT "AV WAIT";USING AB$;SQ,SP
1900 PRINT "AV LINE";USING AB$;SO,SN
1910 PRINT "NUM PAT";USING AB$;SL,SM
1920 PRINT "OFF TIM";USING AB$;SJ,SK
1930 INPUT "DO YOU WISH HISTOGRAMS (Y/N)";Z$
1940 IF Z$="Y" GOTO 3000
1950 END
1990 REM ## ARRIVALS WITH APPOINTMENTS ##
2000 I=0:K=0
2010 I=I+1:C(I)=1:IF I=1 GOTO 2060
2020 J=RND(100)
2030 IF J=98 THEN C(I)=3
2040 IF J>98 THEN C(I)=2
2050 IF C(I)>1 GOTO 2090
2060 TA(I)=PT*K
2070 K=K+1
2080 GOTO 2100
2090 TA(I)=TA(I-1) + RND(PT)
2100 IF TA(I)<TX GOTO 2010
2110 NP=I-1
2120 RETURN
2990 REM ## HISTOGRAM PLOTTING ##
3000 DATA "MAXIMUM IDLE TIME","MAXIMUM WAIT TIME","MAXIMUM LINE LENGTH","AVERAGE
PERCENT IDLE","AVERAGE WAIT TIME","AVERAGE LINE LENGTH"
3010 FOR J=1 TO 6
3020 READ TL$
3030 CLS:PRINT "** HISTOGRAM FOR ";TL$:PRINT
3035 REM ## FIND MAXIMUM VALUE ##
3040 AX=-99.
3050 FOR I=1 TO NI
3060 IF AD(J,I)<AX GOTO 3080
3070 AX=AD(J,I)
3080 NEXT I
3085 REM ## DIVIDE INTO TEN BINS ##
3090 AB=1.01*AX/10.
3100 AU(0)=0.0
3110 FOR K=1 TO 10
3120 AL(K)=AU(K-1)
3130 AU(K)=AU(K-1)+AB
3140 BN(K)=0
3150 NEXT K
3155 REM ## PUT DATA INTO BINS ##
3160 FOR I=1 TO NI
3170 FOR K=1 TO 10
3180 IF AD(J,I)>AU(K) GOTO 3210
3190 BN(K)=BN(K)+1
3200 GOTO 3220
3210 NEXT K
3220 NEXT I
3230 MX=-99
3240 FOR K=1 TO 10
3250 IF BN(K)<MX GOTO 3270
3260 MX=BN(K)
3270 NEXT K
3280 AF=1.0
3285 REM ## LIMIT MAX BIN QUANTITY TO 40 ##
3290 IF MX>40 THEN AF=40./MX
3300 FOR K=1 TO 10
3310 BP(K)=BN(K)*AF
3320 PRINT USING "###.##-###.##  ";AL(K),AU(K);
3330 PRINT STRING$(BP(K),"*");
3340 PRINT TAB(55)BN(K)
3350 NEXT K
3360 FOR K=0 TO 4
3370 PRINT TAB(13+10*K)INT(10*K/AF);
3380 NEXT K
3385 PRINT
3390 INPUT "PRESS ENTER WHEN REVIEW COMPLETE";Z$
3400 NEXT J
3410 END
```

Take the Headaches Out of Tax Preparation

Program Listing "F"

```
10 DEFDBL I
15 CLEAR 4000
20 DIM D$(10),I(179),I$(179),L$(179)
25 CLS
30 PRINT"THE ACTION CODES ARE:"
40 PRINT"0 END"
50 PRINT"1 READ A FILE"
60 PRINT"2 PRINT 1040 PAGE 1"
65 PRINT"3 PRINT 1040 PAGE 2"
70 PRINT"4 PRINT SCHEDULE A"
80 PRINT"5 PRINT SCHEDULE B"
90 PRINT"6 PRINT SCHEDULE C"
100 INPUT"YOUR SELECTION ";A:IFA<0ORA>6THEN25
110 GOSUB9000:IFA>0THEN130
120 CLS:PRINT MEM:GOSUB9000:END
130 ON A GOTO 140,200,300,400,500,600
140 CLS:INPUT"FILE NAME ";Z$:OPEN "I",1,Z$
142 CLS:FORA=1TO177:PRINT@0,"READING";A;" OF 177";:INPUT#1,I(A)
144 INPUT#1,I$(A):FORS=1TO10:S1=S2*0:NEXTS,A
146 FORA=1TO10:INPUT#1,D$(A):NEXT
148 INPUT#1,D1$,D2$,D4$,D5$,D6$,D1,D7$,D2
180 CLOSE 1:GOTO25
200 GOSUB8900
210 FORA=1TO8:LPRINT" ":NEXT
220 LPRINTD$(1);TAB(56)LEFT$(D$(4),11):LPRINT" "
222 LPRINTD$(2);TAB(56)LEFT$(D$(5),11)
223 LPRINTTAB(56)LEFT$(D$(6),12)
224 LPRINTD$(3); TAB(56)LEFT$(D$(7),12):IFD1$<>"Y"THEN226
225 LPRINT TAB(42)"X":GOTO228
226 LPRINT TAB(50)"X"
228 LPRINT" ":IFD2$<>"Y"THEN230
229 LPRINT TAB(42)"X":GOTO231
230 LPRINT TAB(50)"X"
231 LPRINT" ":LPRINT" ":LPRINT" "
232 FORA=1TO5
234 IFI(1)=ATHENLPRINT TAB(8)"X";
236 LPRINT" ":IFA=3THENLPRINT" "
238 NEXTA
240 LPRINT TAB(8)"X";
242 IFD4$="Y"THENLPRINT TAB(28)"X";
244 IFD5$="Y"THENLPRINT TAB(46)"X";
246 LPRINT" ":IFI(1)=2THEN LPRINT TAB(8)"X";
248 IFD6$="Y"THEN LPRINT TAB(28)"X";
249 IFD7$="Y"THENLPRINT TAB(46)"X";
250 A=I(2)-D1-D2:LPRINT TAB(62)"     ";A
252 LPRINT" "
254 LPRINT "      ";D$(8);TAB(62)"     ";D1:LPRINT"     ";LPRINT" "
256 LPRINT "  ";D$(9);TAB(62)"     ";D2:LPRINT "      ";D$(10)
258 LPRINT TAB(62)"     ";I(2)
260 FORS=3TO4:GOSUB9100:NEXT:LPRINT" "
262 LPRINT TAB(31)" ";:LPRINT USING"######.##";I(5);
263 LPRINT USING"##########.##";I(6),:S=7:GOSUB9100
265 LPRINT" "
267 FORS=8TO16:GOSUB9100:NEXT
269 S=17:GOSUB9200
271 S=18:GOSUB9100:LPRINT" ":S=19:GOSUB9100:S=20:GOSUB9100
273 FORS=21TO27:GOSUB9200:NEXT:S=28:GOSUB9100:LPRINT" "
275 S=29:GOSUB9100
277 FORA=1TO3:LPRINT" ":NEXT
295 GOTO25
300 GOSUB8900:FORA=1TO4:LPRINT" ":NEXT
305 FORS=30TO31:GOSUB9100:NEXT
310 FORA=1TO6:LPRINT" ":NEXT
315 S=32:GOSUB9100
320 FORA=1TO3:LPRINT" ":NEXT
325 FORS=33TO34:GOSUB9100:NEXT
330 LPRINT" ":S=35:GOSUB9100
335 FORS=36TO43:GOSUB9200:NEXT
336 FORS=44TO54:GOSUB9100:NEXT
340 FORS=55TO56:GOSUB9200:NEXT:LPRINT" "
345 FORS=57TO59:GOSUB9200:NEXT:LPRINT" "
350 FORS=60TO61:GOSUB9200:NEXT
355 FORS=62TO64:GOSUB9100:NEXT:S=65:GOSUB9200
360 LPRINT" ":S=66:GOSUB9100
365 FORA=1TO6:LPRINT" ":NEXT
370 LPRINTTAB(56)"PREP SS#"
375 LPRINTTAB(20)"YOUR NAME";TAB(56)"EI NO"
380 LPRINTTAB(20)"YOUR ADDRESS";TAB(56)"ZIP CODE"
385 FORA=1TO3:LPRINT" ":NEXT
395 GOTO 25
400 GOSUB8900:FORA=1TO7:LPRINT" ":NEXT
405 LPRINT TAB(6)D$(1);TAB(56)LEFT$(D$(4),11)
410 LPRINT TAB(56)LEFT$(D$(5),11)
415 FORA=1TO4:LPRINT" ":NEXT
420 S=95:GOSUB9100
425 FORS=67TO69:GOSUB9300:NEXT
430 S=96:GOSUB9100
435 S=70:S1=97:GOSUB9400
440 S=98:GOSUB9410
442 S=71:S1=99:GOSUB9400
444 LPRINT" "
446 FORS=72TO73:GOSUB9300:NEXT
448 FORS=100TO101:GOSUB9100:NEXT:LPRINT" "
450 S=74:S1=102:GOSUB9500
452 S=75:S1=0:GOSUB9500
454 FORS=76TO77:S1=S+27:GOSUB9500:NEXT
456 LPRINT" ":S=105:GOSUB9100
458 LPRINT" ":S=106:GOSUB9100
460 S=78:GOSUB9300
462 S=79:S1=107:GOSUB9600
463 LPRINT"":S=80:S1=108:GOSUB9600
464 LPRINT" ":S=81:S1=109:GOSUB9400
466 FORS1=110TO111:GOSUB9410:NEXT
468 FORS=82TO84:GOSUB9300:NEXT
470 S=85:S1=112:GOSUB9600
472 FORS=86TO87:S1=0:GOSUB9500:NEXT
474 S=81:GOSUB9100
476 S=88:GOSUB9100
478 S=88:S1=94:GOSUB9600
480 S=102:GOSUB9100
482 S=89:S1=107:GOSUB9600
484 S=90:S1=112:GOSUB9600
486 I(0)=I(81)+I(88)+I(94)+I(102)+I(107)+I(112)
487 PRINT USING"#########.####";I(0)
488 S=0:GOSUB9100
490 S=91:S1=0:GOSUB9500
```

(*continued*)

Listing "F" (Continued)

```
492 SS=I(0):I(0)=3400:IFI(1)=3THENI(0)=1700
494 IFI(1)=10RI(1)=4THENI(0)=2300
495 S9=I(1):I(1)=I(0):S=92:S1=1:GOSUB9500
496 S=93:S1=0:GOSUB9500
497 FORA=1TO3:LPRINT" ":NEXT
498 I(1)=SS-I(1):S=94:S1=1:GOSUB9600:I(1)=S9
499 LPRINT" ":LPRINT" ":LPRINT" ":GOTO25
500 GOSUB8900:FORA=1TO5:LPRINT" ":NEXT
505 LPRINT TAB(6)D$(1);TAB(56)LEFT$(D$(4),11)
510 FORA=1TO7:LPRINT" ":NEXT
515 FORS=113TO117:S1=S+5:GOSUB9700:NEXT
520 FORA=1TO29:LPRINT" ":NEXT
525 I(178)=0:I(179)=0:FORS=113TO117:I(178)=I(178)+I(S)
530 I(179)=I(179)+I(S+5):NEXT
535 S=178:GOSUB9300:LPRINT" ":S=179:GOSUB9100
540 FORA=1TO8:LPRINT" ":NEXT:GOSUB9100
550 FORA=1TO7:LPRINT" ":NEXT
595 GOTO25
600 GOSUB8900:FORA=1TO8:LPRINT" ":NEXT
605 LPRINT TAB(6)D$(1);TAB(56)LEFT$(D$(4),11)
610 FORA=1TO15:LPRINT" ":NEXT
615 S=123:GOSUB9900:S=124:GOSUB9900
620 FORS=125TO128:GOSUB9100:NEXT:LPRINT" "
625 S=129:GOSUB9100:LPRINT" ":LPRINT" "
630 FORS=130TO133:S1=S+25:GOSUB9800:NEXT
635 S=134:S1=159:GOSUB9600
640 S=135:GOSUB9300
645 FORS=136TO146:S1=S+24:GOSUB9400:NEXT
650 FORS=147TO149:GOSUB9300:NEXT
655 FORS=150TO154:S1=S+21:GOSUB9400:NEXT
660 S=176:GOSUB9100
670 LPRINT" "
680 S=177:GOSUB9100
684 LPRINT" "
685 LPRINT" "
690 LPRINT" ":LPRINT" "
695 GOTO25
8900 PRINT"SET PAPER TO FIRST LINE OF FORM"
9000 PRINT@1000,"P OR C ?";:Z$=INKEY$
9010 IFZ$="C"THEN9025
9020 IFZ$="P"THEN9040
9022 GOTO9000
9025 S=0:CLS:RETURN
9040 S=15359:FORS1=0TO14:S2=64*S1:FORS3=1TO64
9050 S4=S+S2+S3:S5=PEEK(S4):LPRINT CHR$(S5);
9060 NEXT:LPRINT" ":NEXT:CLS:RETURN
9100 LPRINTTAB(54)" ";:LPRINT USING"##########.##";I(S):RETURN
9200 LPRINT TAB(39)" ";:LPRINT USING"##########.##";I(S):RETURN
9300 LPRINT TAB(17)" ";:LPRINT USING"##########.##";I(S):RETURN
9400 LPRINT TAB(17)" ";:LPRINT USING"##########.##";I(S);
9410 LPRINT TAB(42)I$(S1);TAB(54)" ";:LPRINT USING"##########.##";I(S1)
9420 RETURN
9500 LPRINT TAB(3)I$(S);TAB(17)" ";:LPRINT USING"##########.##";I(S);
9510 IFS1=0THEN9530
9520 LPRINTTAB(54)" ";:LPRINT USING"##########.##";I(S1);
9530 LPRINT" ":RETURN
9600 LPRINTTAB(17)" ";:LPRINT USING"##########.##";I(S);
9610 LPRINTTAB(54)" ";:LPRINT USING"##########.##";I(S1):RETURN
9700 LPRINT TAB(3)I$(S);TAB(17)" ";:LPRINT USING"##########.##";I(S);
9710 GOTO9410
9800 LPRINTTAB(17)" ";:LPRINT USING"##########.##";I(S);
9810 LPRINTTAB(38)" ";:LPRINT USING"##########.##";I(S1)
9820 RETURN
9900 LPRINT TAB(36)" ";:LPRINT USING "##########.##";I(S):RETURN
```

Take the Headaches Out of Tax Preparation

Program Listing "T"

```
1 DEFDBL I
5 CLEAR 4000
10 DIM D$(10),I(177),I$(177),L$(177),T(3,17,2),T1(3,1)
11 D7$="."
15 CLS
50 FORA=1TO177:PRINT@0,"LOADING";A;" OF 177":READZ$:I$(A)=LEFT$(Z$,12)
55 L$(A)=RIGHT$(Z$,3):NEXT:I(1)=1
60 FORA=0TO3:FORB=0TO17:READT(A,B,0),T(A,B,1),T(A,B,2):NEXTB,A
62 FORA=0TO3:READT1(A,0),T1(A,1):NEXT
70 CLS:PRINT"THE ACTION CODES ARE:":PRINT"0  ENDS                    13 START A NEW FILE"
71 PRINT"1  READS A FILE"
72 PRINT"2  SAVES A FILE":PRINT"3  SHOWS TAXES":PRINT"4  INCOME AVERAGES"
74 PRINT"5  INPUT 1040":PRINT"6  PRINT 1040":PRINT"7  INPUT A":PRINT"8  PRINT A"
76 PRINT"9  INPUT B":PRINT"10 PRINT B":PRINT"11 INPUT C":PRINT"12 PRINT C"
80 INPUT"YOUR SELECTION";A:CLS:IFA<0ORA>13THEN70
85 IFA>0THEN95
90 CLS:PRINT"MEMORY FREE=",MEM:END
95 ON A GOTO 100,360,200,250,350,450,500,600,650,655,800,900,7100
100 CLS:INPUT"FILE NAME";Z$
110 CLS:OPEN "I",1,Z$
120 FORA=1TO177:PRINT@0,"READING ";A;" OF 177";:INPUT #1,I(A):INPUT #1,I$(A)
125 FORS=1TO10:S1=S2*0:NEXTS,A
130 FORA=1TO10:INPUT #1,D$(A):NEXT
140 INPUT#1,D1$:INPUT#1,D2$:INPUT#1,D4$:INPUT#1,D5$:INPUT#1,D6$:INPUT#1,D1,D7$
141 INPUT#1,D2
180 CLOSE 1:GOTO70
200 CLS:PRINT"YOUR TAX SUMMARY IS:"
210 PRINT"TOTAL TAXES";:PRINT USING"######.##";I(54)
220 PRINT"TOTAL PAY. ";:PRINT USING"######.##";I(62)
230 PRINT"BALANCE    ";:PRINT USING"######.##";I(54)-I(62)
240 GOSUB9000:GOTO70
250 CLS:PRINT"THIS SECTION ONLY WORKS IF YOU HAVE THE SAME FILING"
252 PRINT"STATUS FOR THE LAST FIVE YEARS"
255 PRINT"GIVE TAXABLE INCOME FOR 1976"
260 PRINT"ADD 3200 IF MARRIED, 1600 IF MARRIED FILING SEPARATELY"
265 PRINT"2200 IF SINGLE OR HEAD OF HOUSEHOLD"
270 INPUT"TO EACH OF THESE YEARS";S1
275 PRINT"GIVE TAXABLE INCOME FOR YEARS 1977,1978,1979"
280 PRINT"LESS 750 FOR EACH DEDUCTION CLAIMED IN"
290 INPUT"EACH OF THESE YEARS";S2,S3,S4
```

```
300 S=I(32):A1=S1+S2+S3+S4:B1=A1*.3
302 S=S-(1000*I(2))
303 J1=I(2):I(2)=0
310 J=I(32):I(32)=B1:GOSUB8930:B1=D:I(32)=C1:GOSUB8930:C1=D
320 B1=(4*(C1-B1))+C1:I(32)=J:I(2)=J1:GOSUB8500
330 PRINT"":PRINT"YOUR TAX IS ";B1;" IF YOU INCOME AVERAGE"
340 PRINT"VERSUS";D;" IF YOU DON'T":GOSUB9000:GOTO70
350 S1=1:S2=1:S3=66:GOTO810
360 CLS:INPUT"FILE NAME";Z$:OPEN"O",1,Z$:CLS
362 FORA=1TO177:PRINT@0,"WRITING ";A;" OF 177"
363 PRINT #1,I(A):PRINT #1,USING"%           %";I$(A):NEXT
365 FORA=1TO10:PRINT#1,USING"%                                        %";D$(A):NEXT
367 PRINT#1,D1$:PRINT#1,D2$:PRINT#1,D4$:PRINT#1,D5$:PRINT#1,D6$:PRINT#1,D1;D7$
368 PRINT#1,D2
374 CLOSE 1:GOTO70
450 S1=3:S2=29:S=5:PRINT"FORM 1040     -PAGE 1":PRINT"====================":PRINT""
460 GOSUB6500:GOSUB9000
470 S1=30:S2=66:S=3:PRINT"FORM 1040     -PAGE 2":PRINT"==================":PRINT""
480 S=3:GOSUB6500:GOSUB9000:GOTO70
500 S1=2:S2=67:S3=112:GOTO810
600 S=3:S1=67:S2=112:PRINT"SCHEDULE A ITEMIZED DEDUCTIONS"
610 PRINT"============================":PRINT"":GOSUB6500
620 PRINT"TOTAL MEDICAL";TAB(34)" ";:PRINT USING "#####.##";I(81)
622 PRINT"TOTAL TAXES";TAB(34)" ";:PRINT USING "#####.##";I(88)
624 PRINT"TOTAL INTEREST";TAB(34)" ";:PRINT USING "#####.##";I(94)
626 PRINT"TOTAL CONTRIB";TAB(34)" ";:PRINT USING "#####.##";I(102)
628 PRINT"TOTAL CASUAL.";TAB(34)" ";:PRINT USING "#####.##";I(107)
630 PRINT"TOTAL MISC.";TAB(34)" ";:PRINT USING "#####.##";I(112)
633 PRINT"LESS";TAB(34)" ";:PRINT USING "#####.##";N9
635 PRINT" ":PRINT"TOTAL DEDUSTIONS";TAB(34)" ";:PRINT USING "#####.##";I(31)
640 GOSUB9000:GOTO70
650 S1=3:S2=113:S3=122:GOTO 810
655 S1=113:S2=117:PRINT"SCHEDULE B":PRINT"==========":PRINT"":S=3
660 GOSUB6500:PRINT"TOTAL INTEREST";TAB(34)" ";:PRINT USING"#####.##";I(4):PRINT" "
670 S=1:S1=118:S2=122:GOSUB6500:GOSUB9000:PRINT"TOTAL DIVIDENDS";TAB(34)" ";
680 PRINT USING"#####.##";I(5):GOSUB9000:GOTO70
800 S1=4:S2=123:S3=175
810 INPUT"A LINE NUMBER OR ALL TO INPUT ALL LINES";Z$
820 IFZ$="ALL"THEN880
825 A=LEN(Z$):IFA=0THEN70
830 IFA>2THEN842
840 IFA=1THENZ$="  "+Z$
841 IFA=2THENZ$=" "+Z$
842 FORA=S2TOS3:IFZ$=L$(A)THEN850
844 NEXT:PRINTZ$;" IS AN IVALID LINE NUMBER":GOTO860
850 IFLEFT$(I$(A),1)<>" "THEN852
851 IFMID$(I$(A),2,1)<>" "THEN855
852 IFLEFT$(I$(A),2)<>"  "THEN855
853 INPUT"THE NAME OF THIS LINE ";Z$:Z$=Z$+"
854 I$(A)=LEFT$(Z$,12):Z$=""
855 PRINT"GIVE YOUR INPUT FOR ";I$(A);:INPUT"  ";I(A)
860 Z$="":INPUT"RETURN TO END OR A LINE NUMBER TO CONTINUE ";Z$
865 A=LEN(Z$):IFA=0THEN895
870 GOTO825
880 Z$=" ":FORA=S2TOS3:IFLEFT$(I$(A),1)<>" "THEN883
882 IFMID$(I$(A),2,1)<>" "THEN894
883 IFLEFT$(I$(A),2)<>"  "THEN890
885 PRINT"INPUT TITLE FOR LINE ";L$(A);:INPUT" ";Z$
887 Z$=Z$+"            .":I$(A)=LEFT$(Z$,12):Z$=" "
890 PRINTL$(A);"    ";I$(A);"    ";:INPUT" AMOUNT ";I(A)
894 NEXT
895 GOSUB8000:GOSUB4500:GOSUB6000:GOSUB7000:GOSUB8000:GOTO70
900 S1=123:S2=177:S=3:PRINT"SCHEDULE C":PRINT"==========":PRINT""
910 GOSUB6500:GOSUB9000:GOTO70
1000 DATA "F. STATUS    1-5","EXEMPTIONS  6-7","WAGES          8"
1002 DATA"INTEREST       9","DIVIDENDS   10A","EXCLUSIONS  10B"
1004 DATA" T. DIVIDEND10C","STATE & L RE 11","ALIMONY REC  12"
1006 DATA" BUS. INCOME 13","CAPITAL GAIN 14","DISTRIBUTION 15"
1008 DATA"SUPPLE. GAIN 16","PENS & ANNUN 17","P A RENT ROY 18"
1010 DATA"FARM INCOME  19","UNEMPLOY COM20A"," TAX UNEMPL.20B"
1012 DATA"OTHER INCOME 21"," TOTAL INC.  22","MOVING EXP   23"
1014 DATA"EMPLOYEE EXP 24","PAY IRA      25","PAY KEOGH    26"
1016 DATA"INT PENALTY  27","ALIMONY PAID 28","DISAB. EXCL. 29"
1018 DATA" TOTAL ADJ.  30"," ADJ. GROSS  31"," ADJ. GROSS  32"
1020 DATA" ITEMIZE DED 33"," TAX INCOME  34"," TAX          35"
1022 DATA"ADD. TAXES   36"," TOTAL TAX   37","CR POL CONTR 38"
1024 DATA"CR ELDERLY   39","CR CHILD CA. 40","INVEST CR.   41"
1026 DATA"CR FOREIGN T 42","CR WIN       43","JOBS CREDIT  44"
1028 DATA"RESID ENG CR 45"," TOTAL CR.   46"," BALANCE     47"
1030 DATA"SELF EMP TAX 48","MINUM. TAX  49A","ALTER. MINUM49B"
1032 DATA"TAX PR YR IN 50","FICA ON TIPS 51","UNCOLL. FICA51B"
1034 DATA"TAX ON IRA   52","EARN INC CR  53"," TOT 47-53   54"
1036 DATA"FED TAX WITH 55","1979 E PAY   56","EARN INC CR  57"
1038 DATA"PAID ON 4868 58","EXCESS FICA  59","CR ON FUELS  60"
1040 DATA"REG CO CREDI 61"," TOT 55-61   62"," OVERPAID    63"
1042 DATA" REFUND TO Y 64","CREDIT TO 80 65"," BALANCE DUE 66"
2000 DATA"INSURANCE     1","MED & DRUGS   2"," 1% OF GROSS  3"
2002 DATA" 2 LESS 3     4","BAL OF INS    5","DOC- DENT- N 6A"
2004 DATA"HOSPITALS    6B","             6C","             6D"
2006 DATA"             6E","             6F"," TOTAL       7"
2008 DATA" 3% OF GROSS  8"," 7 LESS 8     9"," TOTAL EXP   10"
2010 DATA"STALT & L I  11","REAL ESTATE  12","GEN SALES    13"
2012 DATA"PER. PROP.   14","             15","             15A"
2014 DATA" TOT TAXES   16","HOME MORTG   17","CRED. CARDS  18"
2016 DATA"             19","            19A","             19B"
2018 DATA" TOT INT EXP 20","CASH CONTRIB21A","OTHER CASH   21B"
2020 DATA"            21C","            21D","             21E"
2022 DATA"NON CASH     22","CARRYOVER    23"," TOTAL CONTR 24"
2024 DATA"LOSS B INS   25","INSUR REMB   26"," 25 LESS 26  27"
2026 DATA" 100 OR 27   28"," TOT CASUAL. 29","UNION DUES    30"
2028 DATA"             31","            31A","             31B"
2030 DATA" TOT MISC.   32"
3000 DATA"             1A","             1B","             1C"
3002 DATA"             1D","             1E","             2A"
3004 DATA"             2B","             2C","             2D"
3006 DATA"             2E"
4000 DATA"GROSS SALES  1A","RETURNS       1B"," BALANCE     1C"
4002 DATA"COST OF GOOD  2"," GROSS PROF.  3","OTHER INCOME  4"
4004 DATA"TOT INCOME    5","ADVERTISING   6","AMORTIZATION  7"
4006 DATA"BAD DEBT      8","BANK CHARGES  9","CAR & TRUCK   10"
4008 DATA"COMMISSIONS  11","DEPLETION    12","DEPRECIATION 13"
4010 DATA"DUES & PUB   14","EMPLOY BEN.  15","FREIGHT       16"
4012 DATA"INSURANCE    17","INT ON BUS   18","CLEANING      19"
4014 DATA"LEGAL        20","OFFICE SUP   21","PENSION PLAN  22"
4016 DATA"POSTAGE      23","RENT OF PROP 24","REPAIRS       25"
4018 DATA"SUPPLIES     26","TAXES        27","TELEPHONE     28"
4020 DATA"TRAVEL $ ENT 29","UTILITIES    30","WAGES        31A"
4022 DATA"JOBS CREDIT 31B","WIN CREDIT   31C"," TOT CREDITS31D"
4024 DATA" 31A - 31D   31E","             32A","             32B"
4026 DATA"             32C","             32D","             32E"
4028 DATA"             32F","             32G","             32H"
4030 DATA"             32I","             32J","             32K"
4034 DATA"             32O","             32P","             32Q"
4036 DATA"             32R","             32S"," TOT DED.    33"
4038 DATA " NET PROFIT  34"
4500 I(69)=.01*I(29):I(70)=I(68)-I(69):IFI(70)<0THENI(70)=0
4510 I(78)=0:FORS=70TO77:I(78)=I(78)+I(S):NEXT
4520 I(79)=.03*I(29):I(80)=I(78)-I(79):IFI(80)<0THENI(80)=0
4530 I(81)=I(80)+I(67):I(88)=0:FORS=82TO87:I(88)=I(88)+I(S):NEXT
4550 I(94)=I(89)+I(90)+I(91)+I(92)+I(93)
4560 I(102)=I(95)+I(96)+I(97)+I(98)+I(99)+I(100)+I(101)
4570 I(105)=I(103)-I(104):I(106)=100:IFI(106)>I(105)THENI(106)=I(105)
4580 I(107)=I(105)-I(106):I(112)=I(108)+I(109)+I(110)+I(111)
4600 S=3400:IFI(1)=1ORI(1)=4THENS=2300
4610 IFI(1)=3THENS=1700
4620 N1=I(81)+I(88)+I(94)+I(102)+I(107)+I(112)-S:N9=S
4630 IF0>N1THENN1=0
4640 I(31)=N1:RETURN
5000 DATA 0,0,0,2300,0,0
5001 DATA 3400,0,.14
5002 DATA 4400,154,.16,6500,314,.18,8500,692,.19,10800,1072,.21
5005 DATA 12900,1555,.24,15000,2059,.26,18200,2605,.3
5008 DATA 23500,3565,.34,28800,5367,.39,34100,7434,.44
5011 DATA 41500,9766,.49,55300,13392,.55,81800,20982,.63
5014 DATA 108300,37677,.68,9999999,55697,.7
5100 DATA 0,0,0,3400,0,0,5500,0,.14,7600,294,.16
```

(*continued*)

Take the Headaches Out of Tax Preparation

Listing "T" (Continued)

```
7290 INPUT"#2 ARE YOU BLIND";D3$::D7$=D3$:GOSUB7950
7300 GOSUB9000:INPUT"HOW MANY DEPENDENT CHILDREN";S:I(2)=I(2)+S:D1=S
7305 IFD1=0THEN7320
7310 INPUT"THEIR NAMES";Q$:S=8:GOSUB7900
7320 INPUT"HOW MANY OTHER DEPENDENTS";S:I(2)=I(2)+S:D2=S
7330 IFS=0THEN7350
7340 INPUT"DATA LINE 1 FOR OTHER DEPENDENTS";Q$:S=9:GOSUB7900
7345 INPUT"DATA LINE 2 FOR OTHER DEPENDENTS";Q$:S=10:GOSUB7900
7350 GOSUB9000:GOTO70
7900 Q$=Q$+Z$:D$(S)=LEFT$(Q$,36):Q$=Z$:RETURN
7950 IFD3$="Y"THENI(2)=I(2)+1
7960 D3$="":RETURN
8000 I(7)=I(5)-I(6)
8010 I(20)=I(3)+I(4)+I(19):FORA=7TO16:I(20)=I(20)+I(A):NEXT
8020 I(28)=0:FORA=21TO26:I(28)=I(28)+I(A):NEXT
8030 A=I(20)-I(28)+I(17)
8040 B=0:IFI(1)=1ORI(1)=4ORI(1)=5THENB=20000
8050 IFI(1)=2THENB=25000
8060 IFI(1)=3THENB=0
8070 C=A-B:IFC>0THEN8080
8075 C=0:GOTO8100
8080 C=C*.5:IFC>I(17)THENC=I(18)
8100 I(18)=C:I(20)=I(20)+I(18)
8110 I(28)=I(28)+I(27):I(29)=I(20)-I(28):I(30)=I(29)
8120 I(32)=I(30)-I(31):GOSUB8500:I(33)=D:I(35)=I(33)+I(34)
8130 I(44)=0:FORA=36TO43:I(44)=I(44)+I(A):NEXT
8140 I(45)=I(35)-I(44):IFI(45)<0THENI(45)=0
8150 I(54)=0:FORA=45TO53:I(54)=I(54)+I(A):NEXT:I(62)=0
8160 FORA=55TO61:I(62)=I(62)+I(A):NEXT:A=I(54)-I(62)
8170 IFA<0THENI(63)=0-A
8180 IFI(63)>0THENI(64)=I(63)-I(65)
8185 IFI(63)=0THENI(65)=0
8190 IFA>0THENI(66)=A
8200 RETURN
8500 A=I(1):IFA=5THENA=2
8515 A=A-1
8520 IFI(2)>T1(A,0)ORI(32)>T1(A,1)THEN8900
8530 D=I(32)-(1000*I(2)):IFD>T(A,1,0)THEN8535
8532 D=0:RETURN
8535 FORB=0TO17:IFD<=T(A,B,0)THEN8545
8540 NEXT
8545 E=INT(D/50):IF(50*E)<>DTHENE=E+1
8550 F=E-1:E=E*50:F=F*50
8555 E=E-T(A,B-1,0):E=E*T(A,B,2):E=E+T(A,B,1)
8560 F=F-T(A,B-1,0):F=F*T(A,B,2):F=F+T(A,B,1)
8565 D=INT((E+F+1)/2):RETURN
8900 D=I(32)-(1000*I(2))
8902 FORB=0TO16:IFD<=T(A,B,0)THEN8910
8905 NEXT
8910 D=D-T(A,B-1,0):D=D*T(A,B,2):D=D+T(A,B,1)
8920 RETURN
8930 A=I(1):IFA=5THENA=2
8940 A=A-1:GOTO8900
9000 PRINT @1000,"P OR C ?";:X$=INKEY$
9010 IFX$="C"THEN9025
9020 IFX$="P"THEN9040
9022 GOTO9000
9025 S=0:CLS:RETURN
9040 S=15359:FORS1=0TO14:S2=64*S1:FORS3=1TO64
9050 S4=S+S2+S3:S5=PEEK(S4):LPRINT CHR$(S5);
9060 NEXT:LPRINT " ":NEXT:CLS:S=0:RETURN
5103 DATA 11900,630,.18,16000,1404,.21,20200,2265,.24
5106 DATA 24600,3273,.28,29900,4505,.32,35200,6201,.37
5109 DATA 45800,8162,.43,60000,12720,.49,85600,19678,.54
5112 DATA 109400,33502,.59,162400,47544,.64
5114 DATA 215400,81464,.68,9999999,117504,.7,0,0,0
5200 DATA 0,0,0,1700,0,0,2700,0,.14,3800,147,.16
5203 DATA 5950,315,.18,8000,702,.21,10100,1132.5,.24
5206 DATA 12300,1636.5,.28,14950,2252.5,.32,17600,3100.5,.37
5209 DATA 22900,4081,.43,30000,6360,.49,42800,9839,.54
5212 DATA 54700,16751,.59,81200,23772,.64,107700,40732,.68
5215 DATA 9999999,58752,.7,0,0,0
5300 DATA 0,0,0,2300,0,0,4400,0,.14,6500,294,.16,8700,630,.18
5304 DATA 11800,1026,.22,15000,1708,.24,18200,2476,.26
5307 DATA 23500,3308,.31,28800,4951,.36,34100,6859,.42
5310 DATA 44700,9085,.46,60600,13961,.54,81800,22547,.59
5313 DATA 108300,35055,.63,161300,51750,.68
5315 DATA 9999999,87790,.7,0,0,0
5400 DATA 3,20000,9,40000,3,20000,8,20000
6000 N2=I(113)+I(114)+I(115)+I(116)+I(117)
6010 N3=I(118)+I(119)+I(120)+I(121)+I(122)
6020 I(4)=N2:I(5)=N3:RETURN
6500 FORA=S1TOS2:IF LEFT$(I$(A),1)<>" "THEN6520
6505 IF MID$(I$(A),2,1)=" "THEN6520
6510 PRINTL$(A);"    ";I$(A);TAB(34)" ";:PRINT USING"#####.##";I(A):GOTO6530
6520 PRINTL$(A);"    ";I$(A);TAB(34)" ";:PRINT USING"#####.##";I(A)
6530 S=S+1:IFS=15THENGOSUB9000
6540 NEXT:RETURN
7000 I(125)=I(123)-I(124):I(127)=I(125)-I(126):I(129)=I(127)+I(128)
7010 S=0:FORA=130TO154:S=S+I(A):NEXT:I(158)=I(156)+I(157)
7020 I(159)=I(155)-I(158):FORA=159TO175:S=S+I(A):NEXT
7030 I(176)=S:I(177)=I(129)-S:I(10)=I(177):RETURN
7100 Z$="      ":FORS=1TO177:I(S)=0:NEXT:FORS=74TO77:I$(S)=Z$:NEXT
7110 FORS=86TO87:I$(S)=Z$:NEXT:FORS=91TO93:I$(S)=Z$:NEXT
7120 FORS=97TO99:I$(S)=Z$:NEXT:FORS=109TO111:I$(S)=Z$:NEXT
7125 D7$="."
7130 FORS=113TO122:I$(S)=Z$:NEXT:FORS=160TO175:I$(S)=Z$:NEXT
7140 CLS:Z$="                                        ."
7150 PRINT"              ==================================="
7160 INPUT"NAME         ";Q$:S=1:GOSUB7900
7170 INPUT"ADDRESS 1/2";Q$:S=2:GOSUB7900
7180 INPUT"ADDRESS 2/2";Q$:S=3:GOSUB7900
7190 INPUT"SS# 1        ";Q$:S=4:GOSUB7900
7200 INPUT"SS# 2        ";Q$:S=5:GOSUB7900
7210 INPUT"OCCUPAT. #1";Q$:S=6:GOSUB7900
7220 INPUT"OCCUPAT. #2";Q$:S=7:GOSUB7900
7223 GOSUB9000
7225 INPUT"FILING STATUS 1 TO 5";I(1):IFI(1)<1ORI(1)>5THEN7225
7228 PRINT"ANSWER Y FOR YES OR N FOR N"
7230 INPUT"#1 $1-CAMP.";D1$
7240 INPUT"#2 $1-CAMP.";D2$
7250 I(2)=1:IFI(1)=2THENI(2)=2
7260 INPUT"#1 ARE YOU OVER 65";D3$:D4$=D3$:GOSUB7950
7270 INPUT"#1 ARE YOU BLIND";D3$:D5$=D3$:GOSUB7950
7280 INPUT"#2 ARE YOU OVER 65";D3$:D6$=D3$:GOSUB7950
```

(*continued from page 79*)

More Space for NCC

The largest exhibition of technological advances in the computer industry in the history of the National Computer Conference will be displayed at NCC '81, May 4 to 7, in McCormick Place, Chicago. According to NCC '81 Chairman Albert R. Hawkes, some 230,000 net square feet of exhibit space has become available with the opening of a new exhibit area in the Lower Concourse level of McCormick Place.

More than 525 exhibitors have already reserved space and many others are still on the waiting list. NCC '80 in Anaheim, which drew 460 exhibiting companies, utilized 180,000 square feet of space in four different locations. Attendance in Anaheim reached upwards of 80,000 people.

For the first time this year, the NCC Personal Computing Festival exhibits will be integrated within the main exhibit area, although the Personal Computing Festival sessions will continue to be separate from the main program.

In addition to the exhibits, conference registrants will be able to participate in about 100 sessions in the main program, the Personal Computing Festival, 21 Professional Development Seminars designed to expand their professional expertise, a Pioneer Day program which will provide historical perspectives of the computer industry, and many other activities.

For more information, contact: AFIPS, P.O. Box 9658, 1815 N. Lynn St., Arlington, VA 22209; (730) 558-3610.

School Software Project

Ohio State University's College of Education has begun a project to develop and disseminate exemplary curricular materials in which high technology is used to teach basic mathematical skills including problem solving, estimation and computer literacy.

Funded by the U.S. Department of Education, the project will collect and evaluate existing educational software for microcomputers (Apple, TRS-80, Pet, and so forth) and select high-quality units for inclusion. Other curricular elements will be developed by the project under the direction of Suzanne Damarin, Marlin Languis and Richard Shumway. The curricula will be field tested and disseminated nationally.

Individuals or groups who have developed programs related to mathematics at the upper elementary school level are invited to submit them for possible inclusion for national dissemination. For further information, contact: Dr. Suzanne K. Damarin, TABS Project, Arps Hall 202-A, 1945 N. High St., Columbus, OH 43210; (614) 422-1257.

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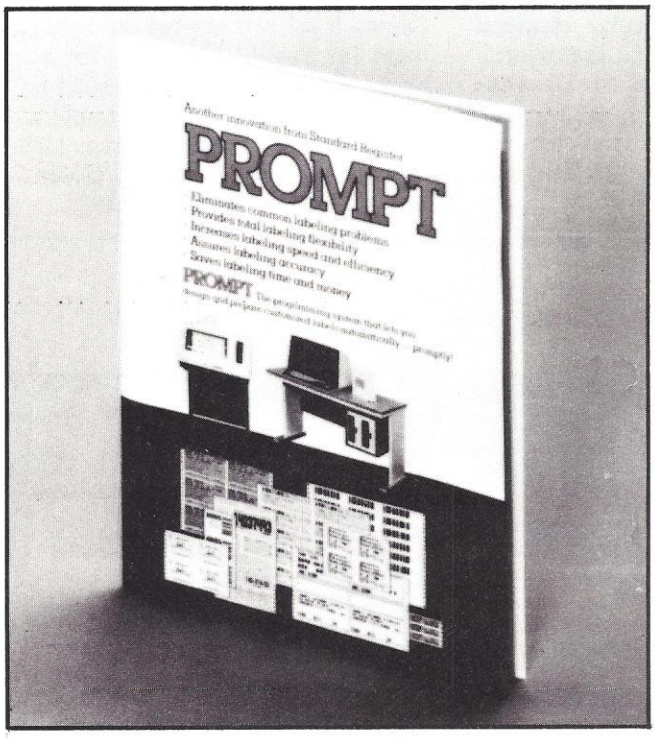
continued from page 86



one complete system.

The system's flexibility is explained and illustrated through a variety of possible label formats. Diagrams show how the information is stored in an electronic file on diskettes for immediate retrieval and use. This reduces costly mistakes, allows for last-minute changes, and eliminates wasteful physical storage space of pre-printed labels.

The PROMPT brochure also lists a variety of print options available to best meet the needs of any operation. The large-character printing improves the effectiveness of shipping labels, bills of lading, production identification, etc. Total control of output is guaranteed, saving time and money.

An illustration of the PROMPT hardware system and a specifications chart are also included in the brochure, listing dimensions, temperature, and power requirements.

The PROMPT system brochure is available free by writing to: The Standard Register Company, P.O. Box 1167, Dayton, OH 45401. *Circle No. 116.*

Condensed, Full Product Line Brochure

Connecticut microComputer, Inc. has published a condensed, six-page short form catalog describing the company's complete line of AC remote controls, data acquisition modules, printer adaptors, and interfaces for use with all popular microcomputers.

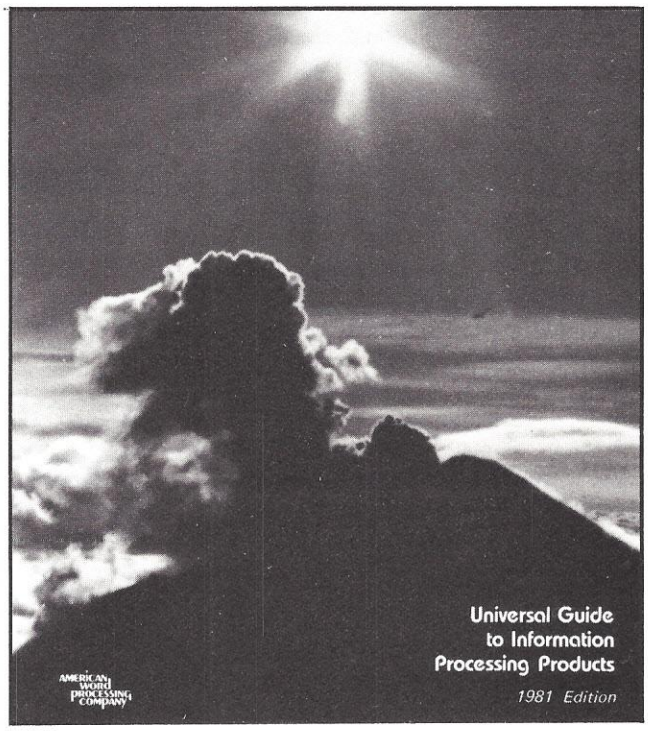
According to the literature, CmC has developed a wide range of accessories and interfaces to enhance the utility of microcomputers including TRS-80, Apple, PET, and KIM. In addition, data acquisition modules allow the input and control of real world variables such as weight, temperature, pressure, humidity, speed, and fluid level. A brief look at each of CmC's ten basic products, plus a capsule history of the company itself, are provided.

For a free copy, write: Brochure, Connecticut microComputer, Inc., 34 Del Mar Drive, Brookfield, CT 06804. *Circle No. 117.*

Data- Word-Processing Accessories And Supplies

The American Word Processing Company has announced the publication of the 1981 Edition of their 104-page "Universal Guide to Information Processing Products," containing over 2,200 specialty products for data- word-processing, and microfiche users.

New products which have been added include: a combination sheet/envelope feeder for daisywheel and NEC printers; 96-character typing elements for IBM electronic typewriters; the "Forms Caddy" for easy movement of continuous-form paper; the "Data Drawer" for printouts, printwheels, data cartridges, or cassettes; systems furniture and continuous form stands, as well as many other types of accessories.



The book also contains 23 pages of compatibility and cross-reference charts, facilitating the location of the correct ribbon, floppy, cassette, print wheel or thimble for many different makes and models of equipment.

You can obtain your free copy by writing or calling: American Word Processing Company, 18730 Oxnard Street, Tarzana, CA 91356. In California, call: (213) 705-2245, elsewhere, call: (800) 423-5220. *Circle No. 118.*

Data General Publishes Networking Brochure

A new brochure, published by Data General Corporation, describes the firm's XODIAC™ Network Management System.

Entitled: "The Shortest Distance Between Two Points," the brochure describes the XODIAC software's versatile modular design; its adherence to CCITT Recommendation X.25 international protocol; and its ability to communicate via high-speed local links, public data networks, and common carriers.

The color brochure also describes XODIAC's ease of use in a distributed data processing environment that includes any host supporting the X.25 protocol.

"The Shortest Distance Between Two Points," No. 012-915, is available from: Communications Services, M. S. C-228, Data General Corporation, 4400 Computer Drive, Westboro, MA 01581.

XODIAC is a trademark of Data General Corporation, Westboro, MA. *Circle No. 119.*

Protecting Your Software

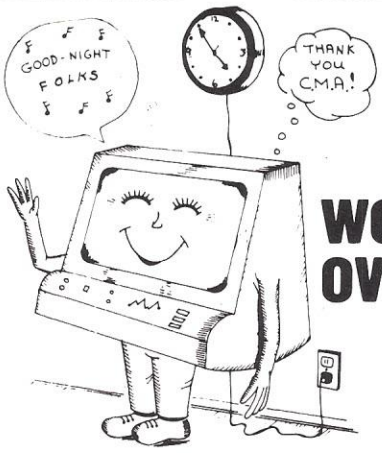
According to Educational Programming Systems, Inc., when a software proprietor begins to consider a legal means of protection for his product, he usually will first look at copyright, patent, and trade secret approaches to determine the method that will give him the greatest protection. At this point, he has already made his first mistake.

So begins the text of *Computers, Copyright and the Law,* a newly published report examining the issue of legal protection for computer software. The report is the product of the Technology-Assisted Learning Market Information Service (TALMIS) of Educational Programming Systems, St. Louis, MO. TALMIS serves firms involved in publishing educational software, particularly for microcomputers. The report was prepared to aid clients in making decisions about protecting proprietary rights to newly-developed software products.

The study introduces readers to the theories behind protection, i.e., disclosure vs. non-disclosure, but the main thrust of the report is a detailed analysis of the pros and cons of the three major proprietary protection methods as they relate to the primary means of dissemination of software products: sale, lease, and license. Particular attention is paid to the Copyright Act of 1976, and the protection afforded by the newly-enacted Computer Software Copyright Act of 1980. The case of *Data Cash vs. JS&A Group* is cited at length as a prime example of what not to do when protecting one's software by copyright.

Computers, Copyright and the Law is part of the "Courseware Development" series of research reports planned by TALMIS for 1981. A related report to be issued in July will deal with hardware and software approaches to anti-copy protection and mass duplication of magnetic media-based software products. Other publications are scheduled in the areas of "Industry Overview" and "Marketing & Sales."

TALMIS is a subscription service designed to provide current information for executives in the growing tech-



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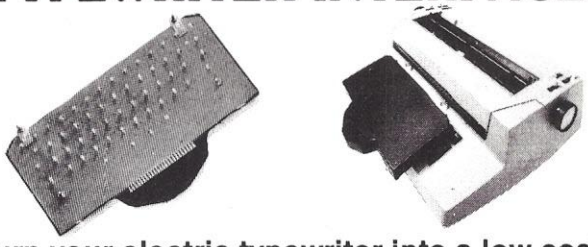

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nology-assisted learning industry, including the areas of publishing, training, audio-visual hardware and software, and computer manufacturing. For more information, contact the Marketing Department of Educational Programming Systems, Inc., 1328 Baur Blvd., St. Louis, MO 63132; (314) 991-0330. *Circle No. 120.*

Update on School MicroWare

School MicroWare, the directory of educational software for microcomputers, is alive, well, and growing by leaps and bounds, according to Bob Haven, SMW's editor and publisher. "With only two issues out, we are gaining acceptance well beyond our expectations," reports Haven. Bob was formerly the Director of Project LOCAL, one of the world's first and longest-lived regional computer-oriented education projects.

School MicroWare describes all types of programs being sold for use in teaching and learning most pre-college subjects at all grade levels. The September full-directory issue included over 500 different products offered by 46 suppliers for use on the Apple, PET, and TRS-80 Model I. The December update issue contained over 100 programs/packages, including offerings from 16 new suppliers, and also added the ATARI micro to the list of machines served. In February, SMW lists 150 more programs, adding 17 more suppliers.

In February, School MicroWare also begins to fulfill its earlier promise to address the software quality problem. SMW does not represent, nor is it compensated by the suppliers whose software it describes. Therefore, it can take an active, objective role in helping both suppliers and users to improve the quality of software being produced. Users need to know how to evaluate software; suppliers need to know what kinds of products users want, and what the standards should be in producing those products. School MicroWare will help satisfy the needs of both parties.

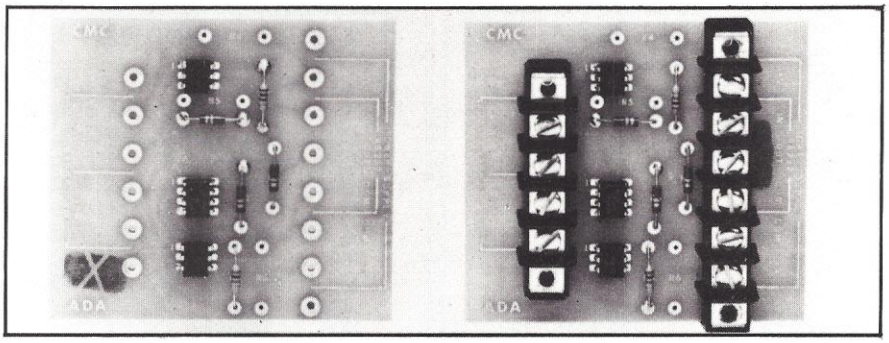
In its February issue, SMW announces a new User Software Review Program. Briefly, this program will enable subscribers to receive, at no cost, scores of software reviews. All they need to do is to obtain and evaluate one or more programs listed in any SMW issue, using the form provided along with the announcement. Dresden Associates, SMW's publisher, will edit these evaluations and publish them in a new semi-annual volume, SMW Reviews. For each evaluation published, the subscriber will receive a free copy of SMW Reviews. Non-subscribers also may take part in the program and will receive a 50 per cent discount on SMW Review's $30 retail price. SMW Reviews also will carry a handy index to reviews done in other books and periodicals. The first edition of Reviews will be available in Summer, 1981.

School MicroWare is available for $20 per year (September's full directory and three updates) from: Dresden Associates, Dept. PC, P.O. Box 246, Dresden, ME 04342. Add $5 per year for foreign subscriptions. Quantity discounts are available. *Circle No. 121.*

(*continued from page 71*)

to the rate at which information is transferred between the computer and the printer. Speeds vary between 110 baud and 19,200 baud, where baud stands for bits per second (remember 8 bits make a byte).

There are two techniques used for the transmission of serial data: synchronous and asynchronous. In the synchronous method, in addition to data being transmitted, a clock signal must also be transmitted on a separate line. This signal is used to determine the beginning of each bit being sent. Another limitation is that data must be sent in a contiguous stream.



A two-circuit RS-232 to current loop adapter is available from Connecticut microComputer. Known as the ADA400, it can be used to convert teletypewriter interfaces to standard RS-232.

In the asynchronous transmission scheme, it is not necessary to send a clock signal, and the transmission of characters need not be contiguous. However in order to do this, it is necessary for the interface to add a few additional bits to the data being sent. A start bit is added to tell the computer that the transmission of a character has started and one or two stop bits are added to indicate when the transmission for a character is ended.

Although the whole subject of printer interfaces can be a confusing one, if you carefully examine the specifications of your computer and your printer, you should not have much difficulty determining whether a Centronics, IEEE 488 or an RS-232C interface would be best for your needs.

Need more information?

For more information on Printer Interfaces readers may consult the software producers and publishers listed here by circling the appropriate numbers on the reader-service card.

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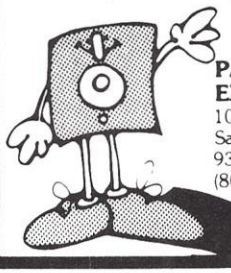

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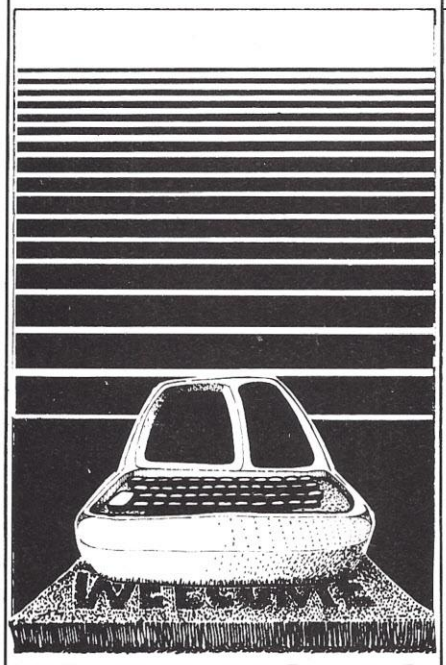

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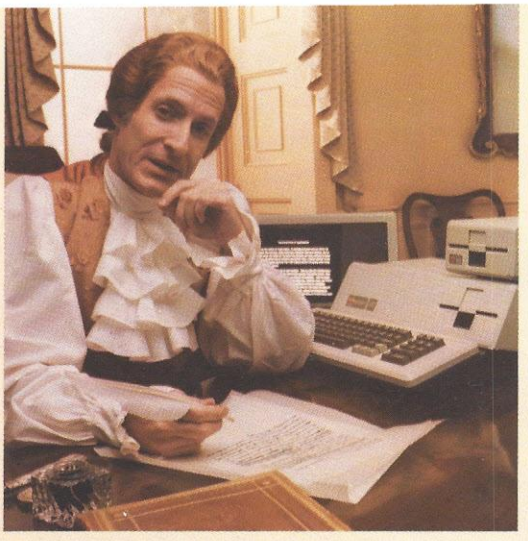

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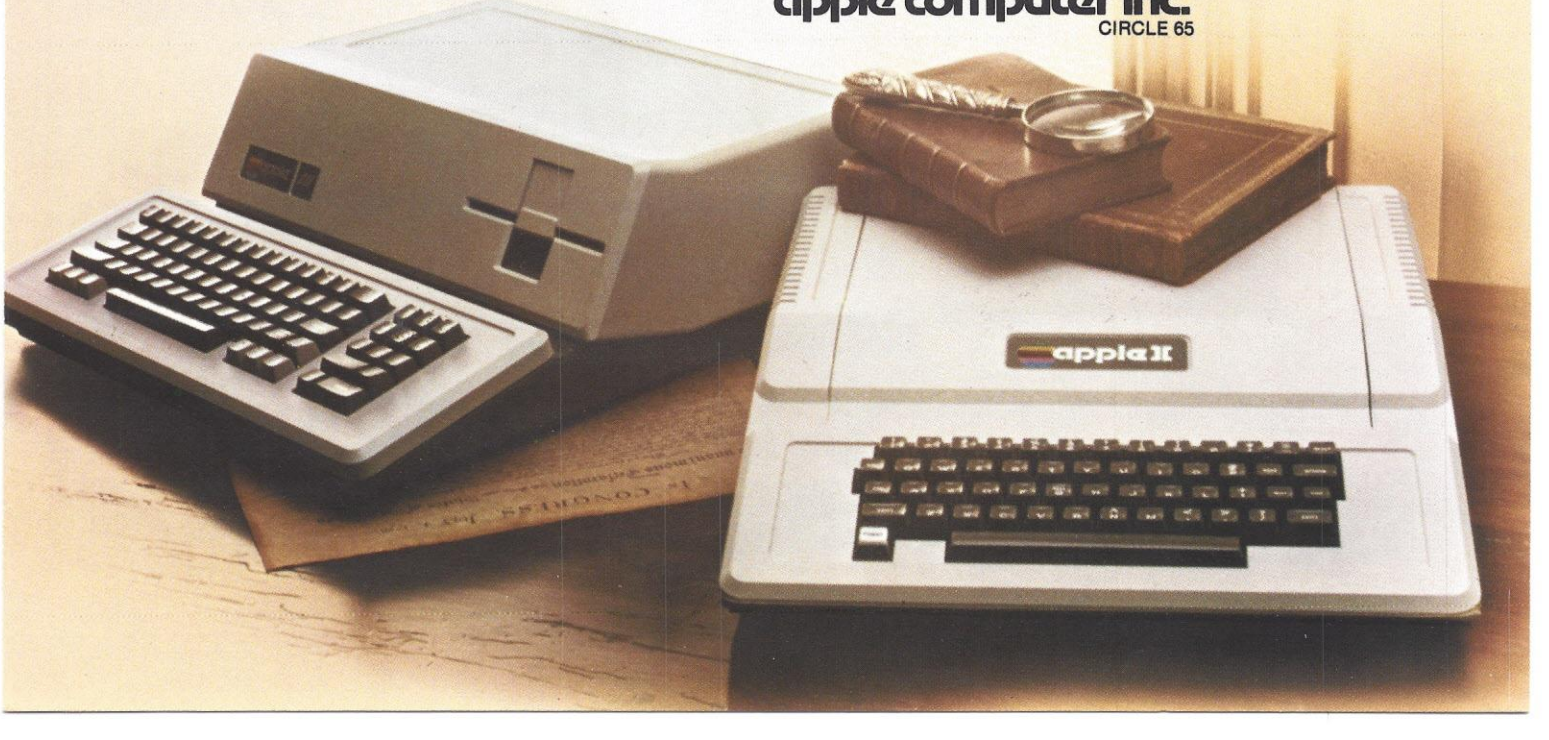

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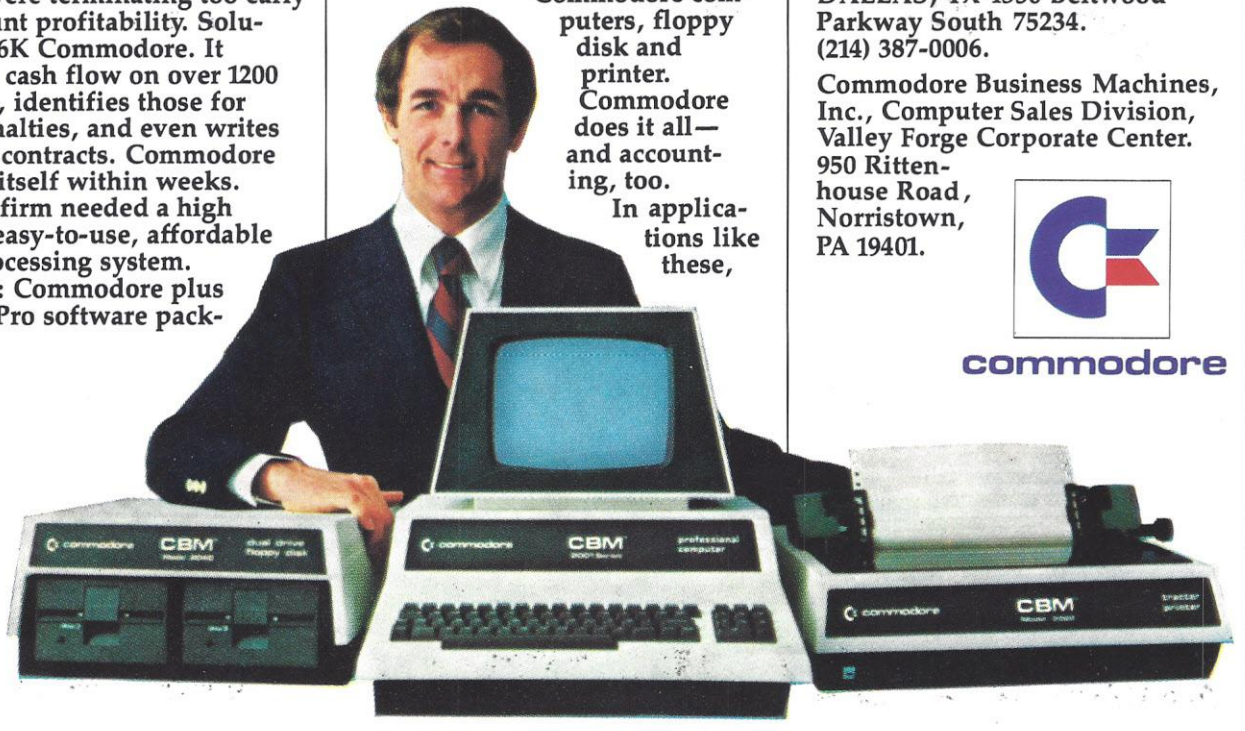

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